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JOURNAL
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VOL. XVII.

A REVISION OF THE SUB-GENUS *SOLANDRA* OF *CENTELLA*.

By R. S. Adamson.

While the genus Centella is widespread especially in tropical and subtropical regions, its subgenus *Solandra* is confined to South Africa and to the south and west coastal belt there. The greatest concentration of species is in the winter rainfall area of the Cape Province.

Centella is a genus closely related to *Hydrocotyle*, and previous to 1878 was usually regarded as forming a part of that genus. Urban (Mart. Fl. Bras. 11.1. 286. 1878) was the first to separate it with a satisfactory diagnosis. His recognition of *Centella* as a distinct genus has been generally followed since (e.g. Drude in Engler & Prantl Nat. Pflanzf. 3.8. 119. 1898; Della Torre & Harms, Gen. Siphonog. 1. 364. 1907; Domin, Bot. Jahrb. 41. 155. 1908; etc.).

The South African species have been studied previously by Chamisso & Schlechtendal (Linnaea 1. 367. 1826), by Sonder (Fl. Cap. 2. 526. 1862) and by Domin (Bot. Jahrb. 41. 155. 1908). In addition Ecklon & Zeyher (Enum. 330. 1837) described a number of species some of which are recognized as valid. All these accounts were based upon somewhat scanty dried material and necessarily resulted in the retention of a number of aggregate groups. Chamisso & Schlechtendal, indeed, came to the conclusion that these groups were not possible of satisfactory division into definable units. Later authors (e.g. De Candolle Prodr. 4. 68–70. 1830, and Sonder (l.c.)) have gone further but with results that can not be regarded as satisfactory. Even the latest, Domin (l.c.) has followed Sonder's scheme very closely though the species are transferred to *Centella*.

More intensive field work, and especially investigation on the higher mountain ranges, together with a study of living plants, has made possible a resolution of some of the previously accepted aggregates and has brought to light a number of new species. In this connection especial tribute must be paid to the collections of Miss E. Esterhuysen of the Bolus Herbarium, which have produced several novelties.

Within South Africa Sonder recognized 15 species, Domin 16, whereas the number is now raised to 38. It is almost certain that even this number will be further increased when more intensive collecting on the more remote mountain ranges is undertaken. There are in collections a number of specimens which cannot be assigned to any of the recognized species but of which material is insufficient for adequate description.

In the present account, in addition to the author's own collections, material from the following herbaria has been examined:—

Bolus Herbarium, University of Cape Town.
Dept. of Botany, University of Cape Town.
S. African Museum, Cape Town.
National Botanic Gardens, Kirstenbosch.
National Herbarium, Pretoria.
Albany Museum, Grahamstown.
Royal Botanic Gardens, Kew.
British Museum (Nat. Hist.), London.
Linnaean Herbarium, London.
Nat. Histor. Riksmuseet, Stockholm.
Bot. Museum, Lund.

Unless otherwise stated, the type specimens of new species or varieties have been deposited in the Bolus Herbarium, Cape Town.

CENTELLA.

L. Pl. Rar. Afr. 28. 1760; Amoen. Acad. 6. 112. 1764. *Emend.* Urban in Mart. Fl. Bras. 11.1. 286. 1878. **Solandra** L. Syst. Veg. ed. 8. 1269. 1759. **Glyceria** Nutt. Gen. Amer. 1. 177. 1818. *non* R. Br. **Chondrocarpus** Nutt. l.c. (in corrig.). **Hydrocotyle** subgen. **Centella** Benth. & Hook. Gen. Pl. 1. 873. 1862.

Perennial herbs, sometimes woody. Stems usually with long and short internodes and the leaves in groups of 2, 3 or more. Leaves simple, the sheaths without stipule-like extensions. Umbels simple, axillary, with 1 to many, most commonly 3, rays. Flowers bisexual and male, solitary on the rays or the male in groups of 3. Male and bisexual flowers in the same or in separate umbels, in the latter case on the same or less commonly on different plants. Involucre 2—4-leaved, involucel of 2 or 4 bracts, persistent at the fruiting stage. Petals imbricate, often incurved. Fruit most often flattened or compressed, without vittae. Mericarps with 7—9 ridges, the commissural as large as the others, the furrows often wrinkled.

The type species is *C. asiatica* (L.) Urban.

In its modern connotation the genus dates from the emendation made by Urban (l.c.) but the name was first used by Linné in 1760 who created the genus for two species, *C. villosa* and *C. glabrata.* Linné however, gave an unsatisfactory and incorrect diagnosis, placing the genus in *Monoecia Tetrandria.* Linné's genus is itself antedated by *Solandra* L. founded in 1759 for the single species *S. capensis,* which was placed in *Monoecia Pentandria,* and which also had an incorrect diagnosis. Linné the younger submerged both these genera in *Hydrocotyle* and his scheme was followed until 1878.

While strict adherence to the International Rules might suggest that the name *Solandra* should replace *Centella,* such a change would be entirely against general usage. *Solandra* has never been correctly diagnosed, and it has never been taken up for the Umbelliferae. Even when a subgenus or section was made in *Hydrocotyle* the name *Centella* was used (e.g. Benth. & Hook. Gen. Pl. 1. 873. 1862; DC. Prodr. 4. 68. 1830). *Solandra* is not mentioned as a genus of Umbelliferae by Steudel (Nom. Bot. ed. 2. 1845). It has, however, been taken up for quite other plants, e.g. Murr. Comm. Gott. 6. 20. 1785 (=*Hibiscus*), Swartz Vet. Akad. Handl. Stockh. 8. 300. 1787 (=*Swartzia*). The case for the adoption of *Centella* rather than *Solandra* has been fully set forth by Domin. (Bot. Jahrb. 148–152. 1908) and needs no repetition.

KEY TO THE SUBGENERA

1. Umbels pedunculate, with 2 or more bisexual flowers; leaf blades reniform, usually cordate .. .. 1. *Trisanthus*

1. Umbels usually sessile, with only 1 bisexual flower .. .. 2. *Solandra*

The connotation of these subgenera which were founded by Drude (l.c.) has been altered somewhat. Drude laid stress on leaf form and habit. He included in the subgenus *Trisanthus* a group of species which have reniform cordate leaves but sessile umbels with only one bisexual flower. In the latter features these species agree with the subgenus *Solandra* and are now transferred thereto. This plan which lays stress on the umbel characters rather than the vegetative ones seems a more natural one. It is one which is supported by the geographical distribution. As now recognized the subgenus *Solandra* is wholly South African while *Trisanthus* is widespread with one species in South Africa. On Drude's division *C. villosa* forms a transition between the subgenera, as revised the two are quite distinct.

Subgen. **Trisanthus.**

Drude in Engler & Prantl Nat. Pflanzr. 3.8. 119. 1898 (*emend.*): *Trisanthus* Lour. Fl. Cochin. 175. 1790 (pro gen.).

Herbs. Leaves petiolate with rounded or reniform obtuse cordate blades. Umbels usually solitary, pedunculate, each with 2 or more bisexual flowers.

The aggregate species *C. asiatica* (L.) Urban has recently been divided into a number of species. Of these segregate species only one has been discovered within the area.

1. **C. coriacea** Nannfd. Svensk. Bot. Tidsk. 18. 404. 1924. *C. asiatica* (L.) Urban Mart. Fl. Bras. 11.1. 287. 1878 *p. pte. Hydrocotyle asiatica* L. Sp. Pl. 234. 1753. *p. pte.*

Glabrous or glabrescent, less often hairy. *Stems* prostrate, branched, usually rooting at the nodes, up to 30 cm. long. *Leaves* solitary or in groups of 2—3, separated by long internodes, petiolate: blades firm, rotund or semicircular, cordate or truncate at the base, more or less crenate, 1—4 cm. long, 1—5 cm. wide: petioles 1—10 cm. long. *Umbels* pedunculate, solitary or in groups: peduncles hairy, 0·5—5 cm. long, shorter than the petioles. *Involucral bracts* 2, membranous, obtuse. *Flowers* 1—5, subsessile, all bisexual. *Petals* glabrous, usually reddish. *Anthers* pale, red or purple, rotund, notched at the tip. *Fruit* 3—4 mm. wide, usually wider than long, the mericarps slightly swollen, brown, wrinkled, longer than the bracts.

The type is *Bachmann* 833 in herb. Berol.

Very variable in size and in the shape and toothing of the leaves, also in the length of the peduncles. The varieties described do not seem more than habitat forms.

Damp places especially where shaded. Common and widely distributed. Throughout the coastal belt and extending throughout the Union.

CAPE. Table Mt., *Burchell* 17; *Froembling;* Mowbray, *Guthrie* 941; Rondebosch, *Adamson* 4026; *Wolley-Dod* 964; 2024; Newlands, *Marloth* 1620; Claremont, *Schlechter* 272; Kirstenbosch, *Adamson* 751; *Barker* 5250; *Compton; Hall* 3; Sand Vlei, *Adamson* 786, 1691; Muizenberg, *Marloth* 3973; Simonstown, *Wright;* S. Peninsula, *Adamson* 912, 3329; *Salter* 2068. STELLENBOSCH. Somerset West, *Parker* 2088; Jonkershoek, *Adamson* 4060. PAARL. Paarl, *Drege.* CALEDON. Elgin, *Adamson* 4274, 4275; Sondereinde, *Adamson* 4388. SWELLENDAM. Voormansbosch, *Ecklon & Zeyher.* RIVERSDALE. Albertinia, *Muir* 850. HERBERTSDALE. Cloete's Pass, *Adamson* 4341. GEORGE. George, *Michell* 16091. KNYSNA. Deepwalls, *J. Phillips* 129; Gouna, *Wall* 2214 18; Prince Alfred Pass, *Fries, Norlindh & Weimarck* 1640. HUMANSDORP. Slang Rust, *E. P. Phillips* 3436. SOMERSET EAST. Boschberg, *MacOwen* 942; Somerset East, *Bolus* 316. UITENHAGE. Uitenhage, *Burchell* 4441; *Ecklon & Zeyher* 483, 2155; *Wallich*· Bethelsdorp, *Fries, Norlindh & Weimarck* 287. PORT ELIZABETH. Port

Elizabeth, *Fries, Norlindh & Weimarck* 76. STEYNSBURG. Zuurberg, *Schonland* 3206. STUTTERHEIM. Amabele, *Acock* 9482. VICTORIA WEST. Woburn, *Acock* 11903. KENTANI. Kentani, *Pegler* 1487. KOMGHA. Komgha, *Flanagan* 1187. HAY. Groot Doorn, *Burchell* 1907; Daniels Kuil, *Wilman* 1329. KIMBERLEY. Kimberley, *A. M. Paton.* VRYBURG. Taungs, *Bruechner* 1231. NATAL. Port Shepstone, *Galpin* 11440; Alexandria, *Rudatis* 1042; Umzimkulu, *Adamson* 4229; Richmond, *Galpin* 12006; Pietermaritzburg, *Dyer* 4770; Durban, *O. Kuntze; Schlechter* 2854; Claremont, *Schlechter* 3090; Greytown, *Wood* 4301; Inanda, *Wood* 839, 839a; Estcourt, *O. West* 1826; Ngongoni, *Acock* 11816. BASUTOLAND. Leribe, *Dieterlen* 619. TRANSVAAL. Belfast, *Burtt-Davy* 1273; Benoni, *R. D. Bradfield* 443; Boksburg, *P. Murray;* Potchefstroom, *W. G. Louw* 1561; Waterberg, *Galpin* 133117; Naboomspruit, *Galpin* 695, M.158; Sabie, *V. Wager* C.10; Zoutpansberg, *O.V.S.* 225. BECHUANALAND. Groot Kuil, *Marloth* 1510. S. RHODESIA. Umtali, *F. Eyles.* Inyanga, *Fries, Norlindh & Weimarck* 3673, 3881, 3939, 3971.

Sub-genus 2. **Solandra.**

Drude in Engler & Prantl Nat. Pflanzf. 3.8. 119. 1898 (*emend.*) *Solandra* L. Syst. Veg. ed. 8. 1269. 1759 (pro. gen.).

Herbs, often woody at the base, or sometimes shrubby. Leaves usually petiolate. Umbels usually sessile, often aggregated, each with only 1 bisexual flower. Mericarps with 7—9 usually small ridges.

The subgenus as created by Drude has been extended to include all the species with only 1 bisexual flower in the umbel.

Key to the Series

- 1. Leaf blades cordate or truncate at the base, the veins diverging from the top of the petiole.
  - 2. Leaves toothed, obtuse, about as wide as long .. .. 1. *Erianthae*
  - *2.* Leaves entire, acute, usually longer than wide .. .. 2. *Villosae*
- *1.* Leaf blades cuneate at the base, not cordate.
  - 3. Basal or all the leaves toothed.
    - 4. Involucral bracts as long as and enclosing the rays of the umbel .. .. 3. *Capenses*
    - *4.* Involucral bracts shorter than the rays .. .. .. 4. *Montanae*
  - *3.* Leaves or most of them entire.
    - 5. Leaves broadly cuneate at the base, usually oblique .. 2. *Villosae*
    - *5.* Leaves narrowly cuneate at the base, usually symmetrical.
      - 6. Leaves flat or occasionally rolled: umbels commonly on lateral branches .. .. 5. *Glabratae*
      - *6.* Leaves terete or if flat very narrow: umbels on the main shoots .. .. 6. *Virgatae*

Series 1. **Erianthae.**

Saepissime pilosae. *Caules* basi lignosi procumbentes. *Folia* petiolata laminis reniformibus vel rotundatis quot latis tot longis saepissime obtusis, marginibus dentatis, nervis radiatis. *Umbellae* sessiles, radiis elongatis, flore unico fertile ceteris masculis. *Fructus* complanatus.

Key to the Species

1. Leaf edge with large triangular teeth: bracts distinctly longer than the fruit.
 2\. Densely hairy: leaves many-toothed: fruit not wider than and enclosed by the bracts .. .. 6. *flexuosa*
 2. Thinly hairy: leaves with 3—9 large teeth: fruit distinctly wider than the bracts.. .. .. 7. *hederaefolia*
1. Leaf edge crenate, dentate, or almost entire, the teeth shallow or very narrow.
 3\. All the leaves distinctly cordate.
  4\. Leaves smooth, concolorous: fruit distinctly ribbed.. 4. *laevis*
  4. Leaves rugose, dark above, paler below: fruit wrinkled, with small ridges.
   5\. Petioles glabrescent, longer than the blades: bracts about as long as the fruit .. .. .. 2. *eriantha*
   5. Petioles densely villous, not longer than the blades: bracts longer than the fruit .. .. 2. *eriantha* var. *rotundifolia*
 3. Upper leaves truncate or very widely cordate at the base.
  6\. Leaves not rugose, thin, with sharp acute marginal teeth: bracts glabrous, shorter than the fruit .. 3. *calliodus*
  6. Leaves rugose, firm, with rather shallow teeth.
   7\. Glabrous or glabrescent: stems herbaceous: leaves not coriaceous: bracts longer than the fruit, usually glabrous .. .. 2. *eriantha* var. *orientalis*
   7. Woolly, at least when young: stems woody: leaves coriaceous: bracts shorter than the fruit, woolly .. .. 5. *lanata*

2. **C. eriantha** (Rich.) Drude in Engler & Prantl Nat. Pflanzf. 3.8. 1191. 1898. *Hydrocotyle eriantha* Rich. Mon. Gen. Hydroc. 18. 1820. *H. reniformis* Spreng. Neu Entdeck. 1. 382. 1821. *H. cuspidata* Willd. in Schult. Syst. 6. 396. 1828. *H. asiatica* Thunb. Fl. Cap. ed. Schult. 252. 1823. *non* L.

A more or less glabrescent prostrate or sprawling herb with slender stems woody in the oldest parts only. *Stems* usually with long internodes, the leaves in groups. *Leaves* glabrescent: blades rotund or reniform, usually deeply cordate, obtuse, 1—3 cm. long, 1·3—4 cm. wide, darker above, paler below, the margins crenate, dentate or almost entire, sometimes slightly lobed, the teeth obtuse, acute or mucronate, occasionally hooked: veins depressed above, prominent below, usually 7, less often 5 or 9, radiating from the top of the petiole, the median not larger than the others: petioles usually hairy, 1—8 cm. long: sheaths hairy. *Umbels* sessile, 3-rayed, but often closely aggregated and apparently many-rayed: rays slender, up to 2 cm. long, hairy or less often glabrous. *Petals* glabrous. *Fruit* orbicular-obcordate, 3—4 mm. long, 3·5—4·5 mm. wide, the mericarps wrinkled, with distinct but not prominent ridges. *Bracts* 2, thin, hairy but glabrescent, as long as the fruit or half its length.

Damp sheltered places on mountains, especially by waterfalls. Throughout the S.W. districts and extending to Natal.

Very variable in leaf-size, the nature of the leaf edge, and in the degree of hairiness; var. *glabrata* Sond. Fl. Cap. 2. 528. 1862. cannot be upheld.

CAPE. Table Mt., *Adamson* 613, 1624, 1625; *Bolus* 4506; *L. Bolus; Burchell* 639; *Compton* 14072; *Drege; Ecklon* 404: *Ecklon & Zeyher* 2157; *Esterhuysen* 34; *Marloth* 123; *Prior*. Devil's Peak, *Prior;* Orange Kloof, *Wolley-Dod* 251. 1002; Noordhoek Mts., *Michell; Salter* 272/4; Muizenberg, *Adamson* 1262, 2312; Kalk Bay Mts., *Adamson* 958; Simonstown, *Adamson* 2367; *Schlechter* 322. STELLENBOSCH. Stellenbosch, *Drege;* Hottentots Holland, *Ecklon & Zeyher* 2158; Lourensford, *Parker* 3936. CALEDON. Somerset Sneeuwkop, *Esterhuysen* 2598: Hangklip, *Compton* 13511: Palmiet Riv., *Andreae* 862; Klein Riv. Mts., *Guthrie* 4125; Houwhoek, *Adamson* 4246: Sir Lowry Pass, *Hafstrom*. PAARL. Franschhoek Pass, *Esterhuysen* 1887; *Barker & Esterhuysen*· Berg River Hoek, *Salter* 6876. WORCESTER. Worcester Mts., *Drege* 1838; *Ecklon & Zeyher*. ROBERTSON. Langeberg, *Levyns* 5507. RIVERSDALE. Langeberg, *Bolus* 11293. GEORGE. George, *Prior*. KNYSNA. Melkhoutskraal, *Burchell* 5369. UNIONDALE. Lourie Plantation, *Dix* 148. HUMANSDORP. Witelsbosch, *Fourcade* 820. UITENHAGE. Van Stadensberg, *Bolus* 1613. PORT ELIZABETH. Port Elizabeth, *F. R. Long* 251. ALBANY. Grahamstown, *Daly & Sole* 499. NATAL. Claremont, *Schlechter* 272. Without exact locality. *Ecklon* 239; *Sparrman*; *Thunberg*; *Zeyher*.

var. **orientalis** var. nov.

A typo differt:—caulibus suberectis vel diffusis, foliis subcoriaceis superioribus basi truncatis vel latissime cordatis, umbellis 4—6 radiatis, fructibus bracteis distincte brevioribus.

More erect. *Leaves* firmer, very slightly rugose, the upper truncate at the base, usually acutely dentate at the edge. *Umbels* aggregated. *Fruit* distinctly shorter than the bracts.

GEORGE. George, *Prior;* Outeniqua Mts., *Rehmann* 270. KNYSNA. Concordia, *J. D. Keet* 598; *The* Glebe, *Galpin* 4092. HUMANSDORP. Assegaibosch, *Rogers* 2847; Witelsbosch, *Esterhuysen* 6795; Riet Vlei, *Esterhuysen* 6612; Clarkson *Thode* A.846. UITENHAGE. Van Stadens Riv. *F. R. Long* 626. ALBANY. Grahamstown, *Rennie* 282 (*type*, in Herb. U.C.T.); *Thode* A.846.

var. **rotundifolia** var. nov.

A typo differt:—caulibus prostratis intricatis sublignosis junioribus dense villosis, foliis rotundatis rugosis supra laete viridibus infra pallidis villosis nervis prominentibus, inferioribus basi profunde cordatis superioribus saepe truncatis, petiolis dense villosis laminas aequantibus vel paulo superantibus, umbellis radiis villosis, bracteis fructibus paulo longioribus.

A variety distinct in the habit with prostrate much branched stems forming close patches. *The younger parts, petioles and umbels* densely white-villous. *Leaf blades* rotund, very rugose, dark green above, pale below, the lower deeply cordate with the edges overlapping, the upper widely cordate or even truncate. *Fruit* slightly shorter than the villous acuminate bracts.

On rocks on the crest of the Potteberg range and on mountains near George.

SWELLENDAM. Potteberg, *Adamson* 4303 (type), 3784. GEORGE. Outeniqua Mts., *Paterson* 1202.

3. **C. calliodus** (Cham. & Schl.) Drude in Engler & Prantl Nat. Pflanzr. 3.8. 119. 1898. *Hydrocotyle calliodus* Cham. & Schlecht. Linnaea 1. 371. 1826.

A slender almost glabrous sprawling or scrambling herb. *Stems* with long internodes, often slightly hairy at the nodes. *Leaves* in groups, often on short shoots: blades thin, palish green, reniform or semicircular, or the lower rotund, usually wider than long, 0·8—3·5 cm. wide, 1·3—3 cm. long, truncate or very widely cordate at the base, concolorous, smooth, with 5, less often 7, radiating veins: veins not depressed above, not or very slightly raised below, the median usually larger than the others: edges dentate or serrate, the teeth mucronate, often long and very narrow, sometimes curved: petioles up to 8 cm. long, almost or quite glabrous: sheaths usually slightly hairy, with obtuse lobes at the top. *Umbels* 3-rayed but often closely approximated, the rays slender, usually slightly hairy. *Flowers* with 4 acuminate bracts. *Petals* glabrous. *Fruit* orbicular, flattened, 3·5—4·5 mm., long 2·5—6 mm. wide, slightly wrinkled, about twice as long as the acuminate bracts. Fruit on a slender usually deflexed ray up to 3 cm. long.

Dripping rocks and sheltered swamps throughout the coastal belt.

Allied to *C. eriantha* but distinguished by the habit, the pale smooth 5-veined leaves with narrow sharp teeth and a truncate base, also by the less ridged fruit with acuminate bracts. Two forms are found which appear rather different but which are connected by all stages of intermediate. The one which occurs at the higher levels, has small leaves not over 2·5 cm. wide with deep marginal teeth, and small fruits about 2·5 mm. wide. The other which is found at lower levels, has larger leaves at least 3 cm. wide which are less deeply toothed, and larger fruits, 3·5—6 mm. diam.

CERES. Cold Bokkeveld, *Adamson* 4296, 4297, 4299. WORCESTER. Worcester, *Rehmann* 2457; Bain's Kloof, *Adamson* 3566, 4383, *Compton* 4169; Du Toit's Kloof, *Drege*. PAARL. Franschhoek Pass, *Adamson* 4085; *Compton* 8164: *Levyns* 4175; Berg River Hoek, *Adamson* 4405; *Compton* 8333; Wemmershoek, *Esterhuysen;* Paarl Mt., *Bunbury; Drege.* STELLENBOSCH. Banhoek, *Stokoe*· Jonkershoek, *Adamson* 3961, 3995, 4066. CALEDON. Hangklip, *Compton* 13540; Palmiet River, *Levyns* 6320; Onrust, *Esterhuysen* 4905; Genadendal, *Ecklon & Zeyher* 2159; *Schlechter* 9867; *Prior;* Paardekop, *Stokoe;* Sondereinde Mts., *Thorn.* SWELLENDAM. Swellendam, *O. Kuntze;* Clock Pks., *Adamson* 3824; *Ecklon & Zeyher* 2159: Buffelsjaagts Riv., *Burchell* 7285; Voormansbosch, *Zeyher* 2663. RIVERSDALE. Garcias Pass, *Schlechter* 1941; Hermans Hoek, *Muir* 396. GEORGE. George, *Bowie.*

Without exact locality:—*Lehmann, Wallich, Zeyher* 2158.

4. **C. laevis** sp. nov. *Hydrocotyle eriantha* var. *glabrata* Sond. F. Cap. 2. 528. 1862. *p. pte.*

Glabrescens. *Caules* suberecti basi lignosi, juvenales villosi. *Folia* reniformia vel rotundata, cordata, crenata vel dentata, laevia, concoloria, nervis supra non depressis, infra vix prominentibus, petiolis glabrescentibus, vaginis subauriculatis. *Umbellae* 3—6 radiatae seapissime separatae, radiis sparse villosis, fructiferis tandem elongatis deflexis. *Fructus* orbicularis vix reticulatis, bracteis aequaelongus vel paulo brevior, mericarpiis jugis subprominentibus.

Allied to *C. eriantha* but larger, usually more erect, and glabrescent except for the coarsely villous youngest parts. *Leaves* smooth, not rugose, almost concolorous, the 7—9 radiating veins forming a network but not depressed above nor prominent below: blades 2—5 cm. long, as wide or wider: petioles 3—10 cm. long. *Umbels* usually solitary. *Fruit* orbicular-obcordate, 3—4 mm. wide, with rather distinct ridges but not or very slightly wrinkled. Fruit on a ray 2—3 cm. long and usually deflexed. *Bracts* acute as long as the fruit or longer, rarely shorter.

River banks and swamps in the southern coastal belt.

CAPE. Orange Kloof, *Guthrie* 1332. STELLENBOSCH. Lourens River, *Parker* 696; Jonkershoek, *Adamson* 3659, 3658; Sir Lowry Pass, *Adamson* 4038 (type). CALEDON. Palmiet Riv., *Mundt; Adamson* 4379; Highlands, *Adamson* 4277; Mossel River, *L. Guthrie;* Sondereinde River, *Adamson* 4387. SWELLENDAM. Potteberg, *Adamson* 3909, 4319. ALBANY. Grahamstown, *MacOwan* 989. Without exact locality:—*Wallich.*

5. **C. lanata** Compton in Kew Bull. 6. 259. 1934.

Prostrate or sprawling. When young covered with dense white or brown woolly hairs, later more or less glabrescent. *Stems* up to 40 cm. long, firm, woody in the lower parts, usually with long internodes. *Leaves* solitary or in groups of 2 or 3: blades coriaceous, reniform, usually wider than long, 1—2 cm. long, 1·5—3 cm. wide, widely cordate or truncate at the base, rugose, not distinctly paler below, the veins slightly depressed above and projecting below, the edges shallowly crenate or dentate: petioles up to 4 cm. long: sheaths with projecting lobes. *Umbels* 3—6 rayed, the rays densely tomentose, 0·4—1 cm. long. *Male flowers* in groups of 2 or 3. *Petals* with a few hairs on the back. *Fruit* orbicular or obcordate, 3—4 mm. long, 3·5—5 mm. wide, pale brown, wrinkled, longer than the acuminate tomentose bracts.

Mountains from Swellendam to Humansdorp.

Readily recognized by the woody stems, coriaceous rugose leaves with a truncate or widely cordate base, and the woolly umbels and young parts.

SWELLENDAM. Voormansbosch, *Pappe; Zeyher* 2661; *Zeyher* (s.n.); Zuurbraak Peak, *Adamson* 4023; Lemoenshoek Peak, *Adamson* 3876; *Esterhuysen* 10439; Langeberg in Heidelberg, *Esterhuysen* 38281. RIVERSDALE. Garcias Pass, *Levyns* 3880; *E. P. Phillips* 319; Campscheberg, *C. Thorn;* Langeberg, *Muir* 109. UNIONDALE. Formosa Peak, *Compton* 4235 (*type* in herb. Kew); Helpmekaar Peak, *Esterhuysen* 4612.

6. **C. flexuosa** (E. & Z.) Drude in Engler & Prantl Nat. Pflanzf. 3.8. 119. 1898. *Hydrocotyle flexuosa* Eckl. & Zeyher Enum. 331. 1837.

Densely covered all over with white, grey or rusty short spreading hairs. *Stems* sprawling, woody at the base only. *Leaves* clustered: petioles up to 10 cm. long: blades cordate, acute 1—2 cm. long, 1—2·5 cm. wide, the edges with large triangular shortly mucronate teeth about 2 mm. deep and 3 mm. wide at the base: sheaths obtuse, with a broad membranous edge. *Umbels* 3-rayed. *Petals* slightly hairy on the back. *Fruit* pale-coloured, orbicular, about 4 mm. long and wide, not wrinkled but with distinct ridges, enclosed by 2 woolly acute or acuminate bracts 7 mm. long and 4—5 mm. wide at the base. Fruit on a ray 2—3·5 cm. long, often deflexed.

Rocks on the upper parts of mountains in the south-west.

Variable in colour. While most generally the fruit is enclosed by the bracts, in some specimens (e.g. *Esterhuysen* 17681) which are otherwise identical, the fruit is distinctly wider than the bracts.

CAPE. Simonstown Mts., *Adamson* 1767. STELLENBOSCH. Hottentots Holland, *Esterhuysen* 2675; *Stokoe* 8995; *Zeyher* 2662; Jonkershoek, *Adamson* 3866, 3994, 3997. CALEDON. Somerset Sneeuwkop, *Esterhuysen* 2599; Sir Lowry Pass, *Bolus* 138; *MacOwan* 138; *Schlechter*

4831; Steenbras, *Burchell* 8222; Elgin, *Compton* 6421; Palmiet River, *Ecklon & Zeyher* 2160 (type). PAARL. Franschhoek Pass, *Esterhuysen* 2807; *Leighton; Schlechter* 3259, 9259; Berg River Hoek, *Compton* 13831; Wemmershoek Tafelberg, *Esterhuysen* 17681. Without exact locality:—*Ecklon* 2160; *Ecklon & Zeyher; Mundt.*

A specimen (*Ecklon & Zeyher* 59.7) stated to have been collected at "Kei River, Tembukiland" is this species but there would seem to be a mistake in the locality.

7. **C. hederaefolia** (Burch.) Drude l.c. *Hydrocotyle hederaefolia* Burch. Trav. 1. 46. 1822. *H. macrodus* Spreng. Syst. 1. 877. 1825. (Neu Entdeck. 2. 292. 1821 (*nomen nudum*)). *H. moschata* Spreng. in Schult. Syst. 6. 351. 1823. *non* Thunb. *H. septemloba* Schinz in Bull. Herb. Boiss. 3. 410. 1895.

Diffuse or sprawling in low patches. Thinly covered all over with long spreading hairs. Underground part of the stem woody, the aerial very slender, much branched. *Leaves* with ivy-like blades 0·8—1·5 cm. long and about the same in width, more or less cordate, the edges with 3—9 large triangular teeth: petioles very slender, up to 5 cm. long: sheaths with a broad scarious edge. *Umbels* 3-rayed, the rays much shorter than the leaves. *Petals* hairy. *Fruit* obcordate, not much flattened, 3—4 mm. long, 3·5—4·5 mm. wide, wrinkled, distinctly wider but much shorter than the acute hairy bracts. Fruit ray about 1·5 cm. long.

Rock crevices on mountain tops. Endemic to the Cape Peninsula.

Allied to *C. flexuosa* and distinguished chiefly on vegetative features. *H. septemloba* was stated to have tomentose fruits but differs in no other feature and cannot be maintained.

CAPE. Table Mt., *Acock* 2717, 6587; *Adamson* 612; *Burchell* 658 (type in Herb. Kew); 659; *Compton; Dümmer; Ecklon* 407; *Ecklon & Zeyher* 2161; *Mundt;* Vlaggenberg, *Adamson* 1750, 1751; *Salter* 1903; Constantiaberg, *Adamson* 2418; *Schlechter* 878 (type of *H. septemloba*); Simonstown Mts., *Schlechter* 372; Wright; Miller's Point, *Wolley-Dod* 2894. Without exact locality:—*Ecklon; Masson; Robertson.*

Series 2. **Villosae.**

Herbae procumbentes caulibus basi tantum lignosis, saepissime dense hirsutae. *Folia* petiolata integra acuta longiora quam lata, basi cordata vel inaequaliter truncata. *Fructus* complanatus.

8. **C. villosa** L. Pl. Rar. Afr. 28. 1760: Amoen. Acad. 6. 112. 1763. *Hydrocotyle villosa* L.f. Supp. Pl. 175. 1781. *H. uncinata* Turcz. Bull. Soc. Nat. Mosc. 20. 1. 169. 1847. *Mercurialis afra* L. Mant. 298. 1767.

Diffuse, more or less prostrate, covered all over with short hairs.

Stems woody at the base only, much branched. *Leaves* usually in groups: blades acute, entire, mucronate, ovate, oblong or oblong-lanceolate, the lower cordate at the base, 1—3 cm. long, 1—2 cm. wide, the upper smaller, cordate, rounded, truncate or very shortly cuneate at the base, usually oblique: central vein distinct, the lower leaves with 2 other longitudinal veins converging towards the tip: petioles slender, 1·5—5 cm. long: sheaths small, not scarious at the edges. *Umbels* 3-rayed but often closely approximated, the rays about 0·5 cm. long. *Male flowers* with 4 bracts, bisexual with 2. *Petals* hairy. *Fruit* flattened, pale-covered, longer than wide, flat-topped, 2—4 mm. long, 1·5—3 mm. wide, almost smooth, not wrinkled, the ridges scarcely projecting. Fruit broader than and as long as or slightly longer than the acuminate hairy bracts.

Rocks on mountains in the western districts.

Variable in leaf shape, leaf size, and in the degree of hairiness and in colour, to a considerable extent in relation to habitat and age. The larger basal leaves wither away in older plants and especially in dry situations. Plants from dry sites are more densely hairy and grey in colour.

Type in herb. Linn.

CLANWILLIAM. Pakhuis Pass, *Esterhuysen* 3420: S. Cedarberg, *Esterhuysen* 17496. CERES. Cold Bokkeveld, *Adamson* 1050, 1114, 4224, 4266, 4287; Elands Kloof, *Drege; Schlechter* 10074; de Straat, *Compton* 6553; Mostert's Hoek, *Bolus*. TULBAGH. Witzenberg, *Burchell* 8704. PIKETBERG. Avontuur Hill, *Pillans* 7390; Porterville, *Esterhuysen* 16220. WORCESTER. Worcester, *Ecklon & Zeyher* 1.1; Hex River, *Tyson* 743; *Wolley-Dod* 4019; *Zeyher;* Prospect Peak, *Esterhuysen* 15945. PAARL. Witte River, *Adamson* 4242: *Esterhuysen* 1974; *Hafstrom;* Witteberg, *Esterhuysen* 16509; Simonsberg, *Drege* 7610; Drakenstein Mts., *Esterhuysen* 1321, 9548; Franschhoek Mts., *E. P. Phillips* 3356. STELLENBOSCH. Stellenbosch, *Harvey*. CAPE. Lion's Head, *Adamson* 1891, 2809; *Wolley-Dod* 2330; Table Mt., *Bolus* 2791. CALEDON. Caledon, *Bolus*. Without exact locality:—*Linné; Thunberg; Zeyher.*

var. **latifolia** (E. & Z.) Adamson in Adamson & Salter Fl. Cap. Pen. 613. 1950 (*emend.*). *Hydrocotyle villosa* var. *latifolia* E. & Z. Enum. 332. 1837. (*p. pte.*). *H. villosa* var. *major* Sond. Fl. Cap. 2. 529. 1862. (*p. pte.*).

Less hairy. *Lower leaves* widely cordate and usually distinctly 3-veined, loosely hairy or glabrescent. *Fruit* circular in outline or wider than long, 3·5—4 mm. long, 4—4·5 mm. wide, twice as long as the bracts: mericarps wrinkled, with narrow curved ridges.

Very distinctive in the characters of the fruit. While most commonly with broad cordate 3-veined leaves there are many transitional stages. The original description of the variety was based entirely on leaf features and is not satisfactory without emendation.

The comparison made by Linné f. of the leaves with those of *Viola odorata* was evidently based on the variety. It is noteworthy that of specimens in the Linnaean Herbarium those named by Linné himself are of the commoner hairy form with small fruits while those added by his son are of this variety.

CERES. Michell's Pass, *Bolus* 5301; Castle Rocks, *Stokoe* 2040; Ceres Peak, *Esterhuysen* 17528. WORCESTER. Du Toit's Peak, *Esterhuysen* 16649. TULBAGH. Witzenberg, *Pillans* 9630. PAARL. Wemmershoek Tafelberg, *Esterhuysen* 17697. STELLENBOSCH. Buller's Kop, *Esterhuysen* 1997. CAPE. Constantiaberg, *Adamson* 2384: Table Mt., *Schlechter* 132. Without exact locality:—*Linné f. Ecklon* 2162.

Series 3. **Capenses.**

Hirsutae. *Folia* cuneata apice vel totius dentata vel lobata. *Umbellae* compactae multiradiatae radiis bracteis involucri brevioribus et eis circumdatis.

Key to the Species.

1. Umbels pedunculate: leaves cuneate-ovate .. .. .. 9. *capensis*
1. Umbels sessile or nearly so.
  2. Leaves channelled, not distinctly petiolate, 3-toothed at the tip: plants thinly hairy .. .. 11. *tridentata*
  2. Leaves flat, cuneate, petiolate, toothed in the upper half: plants densely hairy.
    3. Leaves oblong-cuneate, 3-veined, many-toothed near the tip .. .. 10. *hermanniaefolia*
    3. Leaves narrow-oblong, very narrowly cuneate, 1-veined, 3-toothed at the tip .. .. .. 10. *hermanniaefolia* var. *littoralis*

9. **C. capensis** (L.) Domin. Bot. Jahrb. 41. 161. 1908. *Solandra capensis* L. Sp. Pl. ed. 2. 1407. 1763. *Hydrocotyle Solandra* L.f. Supp. Pl. 176. 1781. *H. tomentosa* Thunb. Diss. Hydroc. 416. 1798. *C. Solandra* (L.f.) Drude in Engler & Prantl Nat. Pflanzf. 3.8. 120. 1898.

In low loose tufts, covered all over with short white or rusty hairs. Underground *stems* woody, branched. *Leaves* crowded, petiolate: blades cuneate, ovate or spathulate, 0·7—2·5 cm. long, 0.6—2 cm. wide, obtusely lobed in the upper part, the tip acute but often much shorter than the lobes: petioles 0·8—3 cm. long: sheaths scarious at the edges. *Umbels* pedunculate, the peduncles 0·8—3 cm. long, as long as the petioles. *Involucral bracts* villous. *Flowers* 5 or 6. *Petals* rather large, white, obtuse, glabrous or with a few hairs on the back. *Disc* prominent, flat, red or yellow. *Fruit* flattened, pale-coloured, about 4 mm. long, 3·5—4 mm. wide, wrinkled, with rather prominent ridges. *Involucral bracts* as long as or longer than the fruit.

Dry lower slopes especially on clay soils throughout the coastal belt. Variable in colour, the degree of hairiness, and in the leaf size and shape. Shade forms have stems with longer internodes and larger leaves, the plants described under *H. Solandra* var. *longifolia* DC. Prodr. 4. 1830 are merely such forms. In the Thunberg collections specimens of both *C. capensis* and *C. hermanniaefolia* are included under his *H. tomentosa*.

CLANWILLIAM. Olifants River, *Ecklon & Zeyher* 2163: *Esterhuysen* 17850. HOPEFIELD. Mamre, *Bolus* 4283. MALMESBURY. Kasteelberg. *Zeyher* 4732. TULBAGH. Tulbagh Kloof. *Bolus* 13560: *Esterhuysen* 6069: *Zeyher*: Tulbagh Waterfall. *Zeyher*. CAPE. Lion's Head, *Burchell* 8450; *Drege; Ecklon* 468; *Ecklon* (*H. tomentosa*); *Kensit; Pappe; Wolley-Dod* 1181; Signal Hill, *E. P. Phillips* 23; *Salter* 272/7; Cape Town, *Alexander; Humbert* 9466; *Marloth* 144; Table Mountain, *Ecklon & Zeyher* 2163; *Pappe; Rehmann* 1361; *Shantz* 68; *Zeyher;* Kloof Nek, *Bunbury:* Devil's Peak, *Thode* A.104; *Tyson* 2438; Green Point, *Prior*; Sea Point, *Bolus* 3967; Camps Bay, *Guthrie* 538 (p. pte.); *Hafstrom; MacOwan* 129, 2314; *C. A. Smith* 2895, 2909; Little Lion's Head, *Adamson* 1186, 3754, 3755: Hout Bay, *Gamble* 22471; *Schlechter* 1224. PAARL. Paarl Mt., *Drege;* Joostenberg, *Esterhuysen* 16203. ROBERTSON. Omklaar. *Stokoe*. MONTAGU. Montagu. *Barnard*. KNYSNA. Knysna. *Gillett* 1281. Without exact locality:—*R. C. Alexander; Ecklon* 5, 2169; *Forsyth; Roxburgh; Harvey* 619; *Pallas; Sparrman; Oldenburg* 288: *Sieber* 140: *Zeyher*.

var. **micrantha** var. nov.

A typo differt:—foliis minoribus angustioribus acute dentato-lobatis umbellis parvis congestis, pedunculis petiolis multo brevioribus, bracteis 4 acutis villosis, flore fertile breviter pedicellato, floribus masculis sessilibus.

Grey-green, in low patches. Aerial *stems* very short. *Leaves* crowded, narrow-ovate, 1·5 cm. long, 0·5—0·7 cm. wide, with narrow acute distinct lobes in the upper part. *Umbels* small, much crowded together, on peduncles 0·5—0·8 cm. long. *Involucral bracts* 4, villous, acute, with many distinct veins. Bisexual *flower* on a pedicel 1—2 mm. long, the male sessile, small. *Petals* glabrous. *Disc* smaller than in the usual form.

Easily distinguished by the narrow acutely toothed leaves and the small crowded umbels on short peduncles.

CLANWILLIAM. Pakhuis Pass, *Adamson* 4260 (*type*).

10. **C. hermanniaefolia** (E. & Z.) Domin. Bot. Jahrb. 41. 161. 1908. *Hydrocotyle hermanniaefolia* Eck. & Zeyh. S.A. Quart. Journ. 375. 1830: (Enum. 333. 1837).

Densely covered all over with short white or yellowish hairs. *Stems* decumbent, woody at the base, laxly branched. *Leaves* usually clustered, petiolate: blades cuneate at the base, more or less rounded and toothed at the tip, 3—4 cm. long, 1—1·8 cm. wide, the veins obscure except the midrib: petioles 2—5 cm. long. *Umbels* often in pairs, almost sessile: peduncles 1—2 mm. long. *Flowers* about 6; rays shorter than the bracts, that of the bisexual flower very short. *Petals* white, densely hairy on the back. *Fruit* about 5 mm. long and wide, flattened, with prominent ridges and much wrinkled furrows.

Local on sands chiefly near the coast in the Port Elizabeth district.

HUMANSDORP. Krakakama *Ecklon & Zeyher* 2164; Gamtoos River, *Hutchinson* 1477. UITENHAGE. Swartkops River, *Bunbury; Ecklon & Zeyher* 2665; *Zeyher* 249 (type). PORT ELIZABETH. Walmert *Paterson* 2347. ALBANY. Kassouga River, *Burchell* 3975. Withou, exact locality:—*Drege* 7613: *Thunberg.*

var. **littoralis** (E. & Z.) Domin. Bot. Jahrb. 41. 161. 1908. *Hydrocotyle littoralis* Eck. & Zeyh. 334. 1837. *H. hermanniaefolia* var. *littoralis* Sond. Fl. Cap. 2. 530. 1862.

More woody than the species, usually white-hairy. *Leaves* much crowded, linear-lanceolate, 2—3 cm. long, 0·3—0·6 mm. wide, 3—5-toothed at the extreme tip, without distinct petioles. *Umbels* smaller, 5-flowered.

Coastal sands in the Swellendam region.

SWELLENDAM. Dunes, *Mundt* (type). BREDASDORP. Cape Agulhas, *Ecklon & Zeyher* 2168, 2169.

11. **C. tridentata** (L.f.) Drude in Engler & Prantl Nat. Pflanz. 3.8. 120. 1898. *Hydrocotyle tridentata* L.f. Supp. Pl. 176. 1781. *Bolax tridentata* Spreng. Prodr. Umbell. 84. 1813. *C. hermanniaefolia* var. *Schlechteriana* Domin. Bot. Jahrb. 41. 162. 1908.

Usually pubescent, from densely hairy to glabrescent. *Stems* woody below ground, the aerial short, little branched. *Leaves* crowded, elongate, narrowly cuneate, 2—5 cm. long, up to 6 mm. wide at the tip, not obviously petiolate, usually grooved above, with 3 small equal acute teeth at the tip: sheaths wide, scarious at the edge, 5—6 mm. long. *Umbels* sessile. *Involucral bracts* 4, lanceolate, acute, 4—5 mm. long, densely villous, either white or brown. *Flowers* sessile, usually 6. *Petals* villous on the back. *Fruit* sessile, compressed, 3·5—4 mm. long and wide, pale-coloured, wrinkled, with rather prominent ridges.

Damp sandy soils at low altitudes in the southern coastal belt.

Specimens (*Schlechter* 9463) which were made the type of *C. hermanniaefolia* var. *Schlechteriana*, most certainly belong to this species.

MALMESBURY. Darling, *Zeyher*. CAPE. Blaauwberg, *Zeyher; Tygerberg, Ecklon & Zeyher* 2167; Vygeskraal, *Wolley-Dod* 1477, 1679; Milnerton, *Adamson* 2483; Cape Flats, *Marloth* 7377; Camps Bay, *Guthrie* 538 (p. pte.); Mowbray, *Guthrie* 237; Rondebosch, *Wolley-Dod* 907; Kenilworth, *Adamson* 1194; Retreat, *Schlechter* 1250; Simonstown, *Adamson* 1339, 1832; *Bolus* 4682; *Salter* 272/9; *Wolley-Dod* 3000; S. Peninsula, *Adamson* 1156, 1913; *Levyns; Salter* 2900. STELLENBOSCH. Kuils River, *Drege; Lamb* 1073. CALEDON. Palmiet River, *Esterhuysen* 13691: Hawston, *Schlechter* 9463. SWELLENDAM. Swellendam, *Mundt: Zeyher* 4. Without exact locality:—*Sir F. Gray; Harvey; Pappe; Thunberg.*

Series 4. **Montanae.**

Folia basalia vel omnia petiolata, cuneata, apice dentata vel lobata. Radii umbellarum bracteis longiores vel aequilongi.

KEY TO THE SPECIES.

1. Umbels with 6 or more rays.
    2. Procumbent, glabrescent: leaves thick, toothed at the tip, all alike: fruit on an elongated deflexed ray .. .. .. 15. *triloba*
    2. Erect: woolly at least when young: lower leaves rounded or oblong, the upper lanceolate: fruit on a short erect ray .. 16. *difformis*

1. Umbels with 3, rarely 4 or 5, rays.
    3. Usually hairy: fruit not longer than the bracts.
        4. Leaves oval, usually acute, with large teeth at the tip.
            5. Loosely villous: petals glabrous: fruit enclosed by the bracts .. .. 12. *montana*
            5. Densely covered with short hairs: petals villous .. 13. *Dregeana*
        4. Leaves rhombic, crenate in the upper half, more or less glabrescent .. .. 14. *Fourcadei*
    3. Glabrescent: fruit much longer than the bracts.
        6. Woolly when young: leaves wedge-shaped, 3 or more toothed at the tip: fruit rounded .. .. .. 17. *dentata*
        6. Glabrous or shortly hairy: leaves ovate or oblong, often entire: fruit longer than wide .. .. 18. *glabrata* (cf. Ser. 5)

12. **C. montana** (Ch. & Sch.) Domin. Bot. Jahrb. 41. 162. 1908. *Hydrocotyle montana* Cham. & Schlechtd. Linnaea 1. 374. 1826.

Loosely villous. Low-growing and almost tufted. *Stems* woody below, with short prostrate or decumbent branches. *Leaves* petiolate, all alike, the upper smaller: blades ovate-lanceolate, 1·5—2·5 cm. long, 0·7—1·2 cm. wide, 3-veined, cuneate at the base, acute at the tip, entire or with 2—5 acute teeth, the median longer than the others: petioles 1—3 cm. long. *Umbels* sessile, 3-rayed, densely and coarsely villous. *Involucral bracts* thin, often scarious, acute, 5—8 mm. long, covered with long hairs. *Rays* 0·5—1 cm. long. *Petals* glabrous, obtuse, as wide as long. *Fruit* circular or broader than long, about 3 mm. wide, black when mature: mericarps rather tumid, with 2 prominent and 2 faint ridges on each face. *Bracts* hairy, acute, at least twice as long as and broader than the fruit.

Upper parts of mountains between Swellendam and the Long Kloof.

A distinctive species but one which has been much confused with *C. difformis* (cf. Journ. S. Afr. Bot. 15. 93. 1949).

The type is *Mundt & Maire* from the Long Kloof Mountains.

SWELLENDAM. Zuurbraak Peak, *Schlechter* 2103; Lemoenshoek Peak, *Adamson* 3880; *Esterhuysen* 10442; *Walgate* 939: Langebergen near Heidelberg, *Esterhuysen* 18262. UNIONDALE. Helpmekaar Mt., *Compton* 5192; Joubertina, *Esterhuysen* 16839, 16840.

var. **longifolia** var. nov.

A typo differt:—foliis longioribus integerrimis lineari-lanceolatis longe petiolatis, umbellis inter folios sessilibus congestis, bracteis angustioribus.

A tufted plant. *Leaves* erect, linear-lanceolate or linear-oblong, entire, 3-veined, glabrescent: blades 2—5 cm. long, 0·5—1 cm. wide: petioles 3—6 cm. long. *Umbels* villous, hidden among the leaves. *Fruit* usually pale-coloured, with bracts about half its width and slightly longer.

Mountains in the Long Kloof.

UNIONDALE. Joubertina, *Esterhuysen* 16767 (type); Lauterwater, *Compton* 5161; Die Hoek, *Esterhuysen* 16371.

13. **C. Dregeana** (Sond.) Domin. Bot. Jahrb. 41. 162. 1908. *Hydrocotyle Dregeana* Sond. Fl. Cap. 2. 530. 1862.

A loosely tufted low-growing plant covered with short hairs but more or less glabrescent. *Leaves* petiolate, crowded: blades ovate, 8—12 mm. long, 4—5 mm. wide, cuneate at the base, acute and usually 5-toothed at the tip: petioles 1·2—2 cm. long. *Umbels* 3-rayed, very shortly pedunculate. *Petals* villous. *Fruit* circular, about 4 mm. diam., the mericarps with 2 distinct ridges on each face. *Bracts* 2, acuminate, slightly longer than the fruit.

Only known from descriptions. Once collected by Drege at Ezelfontein in Namaqualand.

14. **C. Fourcadei** sp. nov.

Herba glabrescens basi tantum lignosa ramis procumbentibus. *Folia* basalia petiolata rhombica apice serrato-dentata, superiora angustiora integra vel apice paucidentata. Umbellae 3—6-radiatae, saepissime 4.

Petala glabra. *Fructus* orbicularis pallidus bracteis aequilongus vel paulo longior.

A sprawling herb, woolly on the youngest parts but generally glabrescent. *Lower leaves* with rhombic blades 3·5—4 cm. long, 2·2—2·8 cm. wide, cuneate at the base, entire on the lower half but sharply toothed on the upper, 3-veined with the veins distinct below: petioles 4—6·5 cm. long: sheaths with obtuse auricles. *Upper leaves* smaller and narrower, either 3-toothed at the tip or the uppermost entire: petioles much shorter. *Umbels* 3—6-rayed, most commonly 4. *Rays* slender, more or less hairy, those with male flowers 7—9 mm. long. *Petals* glabrous. *Fruit* circular, pale-coloured, about 3 mm. diam., the mericarps with 3 small ridges on each face and slightly wrinkled furrows. *Bracts* acuminate, ciliate, as long as or slightly shorter than the fruit. *Fruit ray* erect, 3—4 mm. long.

Lower slopes and flats in the Knysna-Humansdorp region.

HUMANSDORP. Witelsbosch, *Fourcade* 2202 (*type*), 2291.

15. **C. triloba** (Thunb.) Drude in Engler & Prantl Nat. Pflanzf. 3. 8. 120. 1898. *Hydrocotyle triloba* Thunb. Diss, Hydroc. 6. t.3. 1798. *Bolax triloba* Spreng. Prodr. Umbell. 34. 1813.

A stout sprawling or prostrate apparently glabrous herb. *Stems* woody at the base, branched, up to 50 cm. long, often with long stout prostrate ridged lateral branches. *Leaves* clustered, more or less shining green, rather thick, glabrous, petiolate: blades cuneate-spathulate or broadly wedge-shaped, usually 3-veined, 2—5 cm. long, 1·5—4 cm. wide, with 3—9 almost equal acute teeth at the tip: petioles 2—6 cm. long: sheaths ciliate. *Umbels* sessile, many-rayed, the rays as long as or longer than the hairy acuminate involucral bracts. *Petals* hairy. *Fruit* pale-coloured, flattened, 3—4 mm. long, 2·5—3 mm. wide, not much wrinkled, the ridges not prominent. *Bracts* acuminate, half to three-quarter the length of the fruit. *Fruit ray* finally 1—2 cm. long and usually deflexed.

Rocks on mountains in the coastal belt in the Caledon region. More common at higher altitudes but descending to sea level.

CAPE. Muizenberg Mt., *Schlechter* 1298; *Wolley-Dod* 2309. STELLENBOSCH. Gordon's Bay, *Bolus* 9824; Hottentots Holland, *Ecklon & Zeyher* 59.7; *Zeyher* 2664. CALEDON. Sir Lowry Pass, *Bolus* 4532; *Galpin* 12403; *Hafstrom & Acock; Hutchinson* 505; *Marloth* 5186, 10021; Steenbras, *Adamson* 4228; *Esterhuysen* 3032; *Galpin* 12403; *Salter* 4196; Hangklip, *Pillans* 8329; Palmiet River, *Adamson* 4175, 4187; *Barker* 6091; *Levyns* 6329; *Wall*; Houwhoek, *Adamson* 4247; *Bolus* 130, 4532; *Ecklon & Zeyher; MacOwan* 130; Hermanus, *Bolus; J. C. Smuts* 1106; Klein River Mts., *Adamson* 4270; *Guthrie* 314. ROBERTSON. Poesjenets Riv., *Levyns* 5501. Without exact locality:—*Harvey* 624; *Ecklon* 2166.

16. **C. difformis** (E. & Z.) Adamson Journ. S. Afr. Bot. 15. 94. 1949. *Hydrocotyle difformis* Eck. & Zeyh. Enum. 333. 1837. *H. montana* Sond. Fl. Cap. 2. 531. 1862. *non* Cham. & Schl.

More or less erect. Woolly at least when young but generally partly glabrescent. *Stems* short, usually solitary, the flowering branches rigid, 10—40 cm. high. *Basal leaves* rigid, petiolate: blades broadly spathulate, 1—5.5 cm. long, 1—4 cm. wide, rounded at the base, more or less truncate at the tip with 3—11, most commonly 3—5, prominent teeth: petioles 3—25 cm. long. *Upper leaves* smaller, 2—4 cm. long, 0·8—1·5 cm. wide, more or less lanceolate, cuneate at the base, often entire: petioles 1·5—3 cm. long. *Umbels* many-rayed, the rays shaggy, longer than the thin hairy involucral bracts. *Fruit ray* very short, erect. *Petals* hairy on the middle of the back, longer than wide. *Fruit* hairy when young, pale-coloured, 3·5—6·5 mm. long, 3·5—4 mm. wide, the mericarps with prominent ridges and smooth furrows. *Bracts* acute, shaggy, much shorter than the fruit.

Common on heathy sands on mountains in the S.W. coastal belt. Extends from sea level to mountain tops.

Variable in size and in hairiness. Late in the season the basal leaves wither away and specimens may look rather different.

CAPE. Muizenberg Plateau, *Adamson* 3070; *Salter* 272/11, 1805. STELLENBOSCH. Stellenbosch, *Drege*. PAARL. Franschhoek Pass, *Pillans* 7012. CALEDON. Somerset Sneeuwkop, *Esterhuysen* 2596, 2597; Rooi Els, *Adamson* 4272, 4273; *Leighton* 1450; Hangklip, *Adamson* 4225; *Barker* 6092; *Compton* 6107; *Rodin* 3161; Palmiet River, *Adamson* 4164, 4184, 4185, 4214, 4215, 4216; *Barker* 6090; *Compton* 12532; *Esterhuysen* 12613; *Levyns* 3837; *Stokoe; Zeyher* 2666 (*type*); Paardeberg, *Adamson* 4188; Highlands, *Adamson* 4276; Kleinmond, *Compton* 3962; *Esterhuysen;* Bot River, *Adamson* 4099; Onrust, *Compton* 3963; *Esterhuysen* 4233; Hermanus, *Galpin* 12901; *Salter* 5165; Shaws Mt., *Lewis* 53101; *Salter* 5162; Elgin, *Levyns* 3383; Viljoen's Pass, *Salter* 3079; *Wall* 2452; Houwhoek, *Bowie* 9, 10; *Schlechter* 7428; Genadendal, *Burchell* 7672; *Ecklon & Zeyher* 2165; Grietjesgat, *Bolus* 4139; *Ecklon & Zeyher.* BREDASDORP. Elandskloof Mts., *Adamson* 4322, 4324; Cape Agulhas, *Salter* 4115; The Poort, *Acock* 1527; *Esterhuysen* 3021; *Leighton* 21091; Bredasdorp, *Acock* 15460.

17. **C. dentata** sp. nov.

Suberecta ramosa, primo lanata sed glabrescens. *Folia* petiolata laminis obovato-cuneatis apice dentatis vel lobatis. *Umbellae* 3, 4 vel 5-radiatae, radiis longis. *Petala* glabra. *Fructus* orbicularis rugosus bracteis longior in radio elongato positus.

A suberect or sprawling herb, the young parts woolly but later glabrescent except for the sheaths and axils. *Stems* with long internodes, woody only at the base. *Leaves* scattered, petiolate: petioles 2—3·5 cm. long: blades narrow cuneate-obovate, 3—4 cm. long, 4—8 mm. wide, acutely toothed or lobed at the tip, 3-veined, somewhat reticulate when dry. *Umbels* solitary, with 3, 4 or 5 rays up to 1 cm. long. *Petals* glabrous, white, rather large. *Fruit* rounded, 4 mm. diam., 1½ times as long as the bracts: furrows distinctly wrinkled. Fruit on a straight ray 1—2 cm. long.

Rather rare on mountains in the central Langeberg.

SWELLENDAM. Strawberry Hill, *Esterhuysen* 10506: Mts. near Heidelberg, *Esterhuysen* 18282. RIVERSDALE. Garcias Pass, *Esterhuysen* 17221 (*type*).

Series 5. **Glabratae.**

Caules procumbentes raro erecti. *Folia* integra, plana vel raro recurevata, basi cuneata, apice acuta, nervis 1 vel saepe 3. *Umbellae* saepaggregatae saepissime in ramis lateralibus positae, radiis 3 vel 6.

KEY TO THE SPECIES.

1. Fruit on a ray not exceeding its length.
  2. Erect woody plants: leaves oblanceolate, 1-veined: fruit shorter than the broad bracts .. .. 31. *rupestris*
  2. Herbs, woody at the base only, prostrate or sprawling: fruit as long as or longer than the bracts.
    3. Leaves obovate, 1-veined, sessile or shortly petiolate: ♂ flowers numerous: fruit wider than long .. .. 28. *sessilis*
    3. Leaves ovate, oblong or lanceolate, the lower with long petioles: umbels 3-rayed: fruit longer than wide.
      4. Leaves 3-veined, scattered: fruit longer than the bracts 18. *glabrata*
      4. Leaves 1-veined, densely clustered: fruit about as long as the bracts .. .. 27. *pottebergensis*
1. Fruit on a ray greater than its length.
  5. Fruit swollen, the mericarps as thick as wide.
    6. Fruit conical, not narrowed in the middle .. .. 29. *fusca*
    6. Fruit didymous, distinctly narrowed in the middle, the mericarps subspherical .. .. 30. *didymocarpa*
  5. Fruit compressed or flattened, distinctly wider than thick.
    7. Leaves linear, parallel-sided.
      8. Erect: upper leaves sessile: fruit oblong, not over 3·5 mm. long, on an erect ray .. .. 24. *graminifolia*
      8. Sprawling: leaves all petiolate: fruit circular, 4 mm. diam., on a long curved ray .. .. 20. *affinis*
    7. Leaves lanceolate, oblong or ovate.
      9. Fruit distinctly stipitate, rounded: leaves linear-lanceolate .. .. 22. *stipitata*
      9. Fruit not stipitate.
        10. Tufted: stems short: umbels densely villous .. 12. *montana* var. *longifolia*
        10. Not tufted: stems elongated: umbels not densely villous.
          11. Stems woody, ascending: petioles of the lower leaves six times as long as the blades: petals hairy .. 19. *cochlearia*

11. Stems woody at the base only, prostrate or sprawling: petioles not more than twice as long as the blades.

12. Stems often rooting at the nodes, with many short shoots: petals glabrous: fruit longer than wide .. .. 18. *glabrata*

12. Stems not rooting at the nodes, without short shoots.

13. Branches 4-angled: lower leaves with 3—5 projecting veins: fruit not over 3·5 mm. long, not much flattened .. .. 21. *debilis*

13. Branches terete: veins of the leaves not projecting: fruit flattened, at least 3·5 mm. long.

14. Fruit circular, about 4 mm. diam., on a long slender ray .. .. 20. *affinis*

14. Fruit longer than wide.

15. Fruit 4—6 mm. long, much longer than the bracts: leaves 3-veined.

16. Leaves coriaceous: lateral shoots long, prostrate .. .. 18. *glabrata*

16. Leaves not coriaceous; without long lateral shoots .. .. 23. *Comptonii*

15. Fruit not over 4 mm. long, parallel-sided: petals usually hairy.

17. Fruit much longer than the bracts .. 25. *scabra*

17. Fruit not or very slightly longer than the bracts.

18. Softly hairy: petioles longer than the blades: bracts longer than the fruit .. .. 26. *lasiophylla*

18. Scabrid: petioles not longer than the blades: fruit about as long as the bracts .. .. 25. *scabra*

18. **C. glabrata** L. Pl. Rar. Afr. 28. 1760; Amoen. Acad. 6. 112. 1763. emend. *Hydrocotyle glabrata* L.f. Supp. Pl. 176. 1781. *H. bupleurifolia* Rich. Monog. Hydroc. 78. 1820. *C. bupleurifolia* (Rich.) Adamson Journ. S. Afr. Bot. 6. 50. 1940. *H. Centella* Cham. & Schld. Linnaea 1. 375. 1826. *C. Chamissonis* Drude in Engler & Prantl Nat. Pflanz. 3.8. 120. 1898. *H. Centella* vars. *glabrescens* & *latifolia* DC. Prodr. 4. 69. 1830. *H. plantaginea* Spreng. Neu Entdeck. 1. 284. 1820. (*p. pte.*). *C. glabrata* var. *coriacea* Domin. Bot. Jahrb. 41. 164. 1908. *H. falcata* Eck. & Zeyh. Enum. 335. 1837 (*p. pte.*). *H. heterophylla* Schinz Bull. Herb. Boiss. 3. 410. 1895. *H. bupleurifolia* var. *tridentata* Eck. & Zeyh. Enum. 335. 1837.

A low-growing more or less prostrate plant, glabrous, glabrescent or less often shortly hairy. *Stems* woody and branching below ground, the aerial with short internodes but forming long prostrate lateral branches up to 1 mm. long which frequently root at the nodes. The lateral branches often bear erect short shoots. *Leaves* petiolate, variable in size and shape: blades firm, usually coriaceous, distinctly 3-veined, lanceolate, ovate-lanceolate or oblong, 2·5—5 cm. long, 0·4—1·8 cm. wide, cuneate at the base, acute or shortly apiculate at the tip, entire or occasionally 2 or 3-toothed: petioles 0·5—4·5 cm. long, longer on the short than on the long shoots. *Umbels* often crowded on the short shoots, 3-rayed, those on the long shoots usually with ♂ flowers only. *Petals* glabrous or rarely hairy. *Fruit* longer than wide, 3·5—6·5 mm. long, 3—5.5 mm. wide, with rather prominent ridges. *Bracts* acute, shorter than the fruit, varying from very short to two-thirds the length of the fruit. Fruit ray straight or curved, 0·5—1·5 cm. long.

Common and widespread through the coastal belt on lower slopes and flats. Absent at the higher altitudes.

A very variable species in size, leaf shape and texture, and in the degree of hairiness. Some of the variations are related to habitat and to season: plants growing on sand have larger and narrower leaves than those on clays, shade forms have broader and thinner leaves. Late in the season the basal leaves may wither away. The numerous varieties which have been based upon leaf form are of little value and quite impossible to disentangle satisfactorily. Many of them include both forms of this and of related species. Even the toothing of the leaves seems an accidental feature of no diagnostic value; it may be confined to the basal leaves (*H. heterophylla* Schinz) or occur in the upper leaves also (*H. bupleurifolia* var. *tridentata* E. & Z.). The varieties recognized here seem definite entities, some of them possibly specifically distinct.

In the past most authors have treated the species as an aggregate with a number of *formae* or varieties (Cham. & Schlechtd. Linnaea 1. 375. 1826: DC. Prodr. 4. 68. 1830: Sonder Fl. Cap 2. 532. 1862: Domin. Bot. Jahrb. 41. 168. 1908). Richard (Monog. Hydroc. 78. 1820) first attempted a segregation when he distinguished two species, *H. glabrata*, and *H. bupleurifolia*. While his diagnoses are satisfactory he applied the new name (*H. bupleurifolia*) to that part which contains the type of the original species. As under the Rules this must retain the original epithet, his name becomes a synonym.

CLANWILLIAM. Blaauwberg, *Drege;* Nieuwoudt Pass, *Compton* 4778; Olifants River, *Stephens* 7337. TULBAGH. Tulbagh, *Ecklon* 2175. MALMESBURY. Riebeck Kasteel, *Adamson* 4426. CAPE. Table Mt., *Ecklon & Zeyher* 2173; *Schlechter* 132; *Zeyher;* Devil's Peak, *Wolley-Dod* 250; Lion's Head, *Ecklon* 410, 2175; *Esterhuysen* 15760A; *Pappe;* Cape Town, *Humbert* 9441; *Marloth; Mogg* A13691; *Paterson* 79; *Rehmann* 1517; Round House, *Froembling;* Kirstenbosch, *Compton* 2184; *Esterhuysen* 15450; Wynberg, *Salter* 2184; Vlaggenberg, *Adamson* 1753; Constantiaberg, *Adamson* 2375; Pollsmoor, *Adamson* 2791; Noordhoek Mts. *Adamson* 2437; Muizenberg, *Adamson* 1267; *Salter* 272/10, 1895; Steenberg, *Adamson* 2107, 3071; *Salter* 272/33, 8430; Kalk Bay Mts., *Adamson* 2099, 2397, 3626; Simonstown, *Ecklon & Zeyher; Wright.* STELLENBOSCH. Somerset West, *Ecklon* 2174; Jonkershoek, *Adamson* 3838, 4230, 4232, 4237; Banhoek, *Esterhuysen* 11917; Hottentots Holland, *Ecklon & Zeyher* 2172; Stellenbosch Flats, *Garside* 1200; *Marloth* 1868. PAARL. Franschhoek Pass, *Adamson* 4082, 4088; *Esterhuysen* 2708; *Salter* 1936; Dal Josaphat, *Tyson* 895; Du Toit's Kloof Pass, *Esterhuysen* 15818A; Wemmershoek, *Andreae* 761. WORCESTER. Brandt Vlei, *Bolus* 5166; *Rehmann* 2378; Bain's Kloof, *Schlechter* 9198. CALEDON. Sir Lowry Pass, *Hafstrom;* Houwhoek, *Bowie;* Caledon, *Fries, Norlindh & Weimarck* 1410; Swartberg, *Galpin* 4089; *Zeyher;* Bosjesveldt, *Burchell* 7865; Sondereinde Mts. *Burchell* 7553; *Ecklon & Zeyher.* ROBERTSON. McGregor, *Adamson* 4447. SWELLENDAM. Swellendam, *Burchell* 7293; Buffelsjagts, *Burchell* 7277; Potteberg, *Adamson* 4311. KNYSNA. Barrington, *Fries, Norlindh & Weimarck* 1299. UITENHAGE. Swartkops Riv., *Zeyher* 1; Kagaberg, *MacOwan* 1141. PORT ELIZABETH. Port Elizabeth, *Paterson* 1031a. ALEXANDRIA. Nanaga, *Acocks* 12798. KENTANI. Kentani, *Pegler* 793. LIBODE, Port St. Johns, *Acocks* 10963; *Galpin* 3430. NATAL. Alexandria. *Rudatis* 1206. Without exact locality *Ecklon* 2179; *Harvey* 625; *Lehmann; Masson; Marloth* 8909; *Oldenburg.*

var. **natalensis** var. nov.

A typo differt:—foliis strigosis lineari-lanceolatis fasciculatis saepissime 1-nerviis, fructibus in radio tenuissimo elongata positis, obovatis, jugis prominentibus, valleculis tuberculatis tuberculis saepe confluentibus.

Prostrate or sprawling. *Stems* with long internodes and distinctly fasciculate leaves, not rooting at the nodes. *Leaves* strigose or hairy, linear-lanceolate, 2—4 cm. long, 3—5 mm. wide, acute, usually with 1 vein or if 3-veined the lateral very slender: petioles usually shorter than the blades. *Umbels* 3-rayed, often aggregated, the rays 1—2 cm. long. *Petals* glabrous. *Fruit* 5—6 mm. long, 4—4·5 mm. wide, obovate, flat-topped: mericarps with 3 prominent ridges on each face, the furrows with obtuse tubercles forming incomplete secondary ridges. *Fruit* 2—3 times as long as the acute bracts, on a very slender ray 2—3 cm. long.

A very distinct variety possibly worthy of specific rank.

NATAL. Gingolova, *Wood* 10162 (type); Izingola, *Wood* 3007; Inanda *Wood* 319; Izingolweni *Wood* 449; *Gerrard* 1485, 1486; Greytown *B. S. Fisher* 922; Port Edward, *H. A. Wager;* Omsomcaba, *Drege;* Alfred, Harding, *Acock* 12239. TRANSKEI. *Flanagan* 188; Tsolo, *V. Payne.* EAST LONDON. East London, *Galpin* 5782; *Rattray* 1278. STUTTERHEIM. Dohne, *Acock* 9557. BATHURST. Bathurst, *Acock* 11060.

var. **bracteata** var. nov.

A typo differt:—foliis saepissime lineari-lanceolatis, fructibus laevibus, bracteis multo brevioribus, bracteis plus minusve foliaceis.

Differs in the long almost leaf-like bracts which are much longer than the fruit. The fruit is almost smooth with the ridges as scarcely raised lines.

RIVERSDALE. Foothills of Langeberg, *Burchell* 6910 (*type*). STELLENBOSCH. Jonkershoek, *Adamson* 4009 (not extreme).

19. **C. cochlearia** (Domin) Adamson comb. nov. *C. glabrata* var. *cochlearia* Domin. Bot. Jahrb. 41. 165. 1908.

Bushy. *Stems* woody, ascending, branched. The young parts hairy but soon glabrescent. *Aerial stems* sulcate. *Leaves* dull green, coriaceous, crowded, the groups separated by long internodes: blades lanceolate-ovate or linear-oblong, about 1·5 cm. long, 3—4 mm. wide, rather thick, 1-veined, acute or shortly mucronate: petioles of the lower leaves 6—10 cm. long. *Umbels* crowded, 3-rayed, the rays 0·5—1.5 cm. long, hairy. *Petals* hairy. *Fruit* oblong, 4 mm. long, 3 mm. wide, with prominent ridges, as long as or slightly longer than the hairy bracts.

Allied to *C. glabrata* but differing in the habit, the long-petiolate lower leaves with 1 vein, the hairy petals, and the much longer bracts to the fruit. Originally described as a variety. The type material is incomplete; the later specimens collected at Klaver are much better.

VAN RHYNSDORP. Windhoek, *Schlechter* 8367 (*type* in herb. Kew); Klaver, *C. A. Smith* 2614.

20. **C. affinis** (E. & Z.) Adamson comb. nov. *Hydrocotyle affinis* Ecklon & Zeyher Enum. 335. 1837. *C. glabrata* var. *affinis* Adamson Journ. S. Af. Bot. 6. 52. 1940. *C. glabrata* var. *linifolia* Adamson l.c. *C. glabrata* var. *linifolia* f. *flaccida* Domin Bot. Jahrb. 41. 168. 1908. *H. Centella* var. *linifolia* DC. Prodr. 4. 69. 1830 (p. pte.). *H. Centella* var. *linifolia* s-var. *flaccida* Sond. Fl. Cap. 2. 532. 1862.

Slender, sprawling or prostrate, glabrous, glabrescent or rarely hairy. *Aerial stems* many, not rooting nor forming short shoots. Leaves petiolate: blades linear or linear-lanceolate, parallel-sided, 1—4 cm. long, rarely over 5 mm. wide, commonly 2—3 mm., thin, flat or sometimes rolled, 1-veined or if 3-veined the lateral marginal, acute or mucronate at the tip, the mucro often curved: petioles of the lower leaves up to 6 cm. long, shorter in the upper. *Umbels* 3-rayed, often crowded: rays slender 0·4—0·8 cm. long. *Petals* glabrous. *Fruit* flattened, circular in outline, 2·5—4 mm. diam., often emarginate at the tip, much longer than the acute bracts. *Mericarps* with 3 curved ridges on each face and wrinkled furrows. *Fruit ray* very slender, 1—2·5 cm. long, usually curved and deflexed at least at the tip.

Distinguished by the habit, narrow leaves, and especially by the fruit. In the past much confused with narrow leaved forms of *C. glabrata.*

CLANWILLIAM. Olifants River, *Ecklon & Zeyher* 2180. WORCESTER. Matroosberg, *Esterhuysen* 14198. STELLENBOSCH. Faure, *Acock* 5380. CAPE. Doornhoogte, *Ecklon;* Table Mt., *Adamson* 2779, 3018; *Bolus* 1118; *Drege; Ecklon* 412; *Ecklon & Zeyher* 2177 (*type*); *Esterhuysen* 15447, 16606: Devil's Peak, *Wolley-Dod* 914; Lion's Head *Adamson* 2812; Signal Hill, *Adamson* 1848, 2542; Camps Bay, *Humbert* 9416; *Morris* 116; *Wilms* 3249; Stinkwater, *Rehmann* 1363; Rosebank, *Schlechter* 1249; Constantia Nek, *Adamson* 1697; Retreat, *Adamson* 2217; Bergvliet, *Adamson* 2674, 2681; *Lewis* 58653; Muizenberg, *Acock* 512; *Adamson* 3196; Simonstown, *Adamson* 1992; *Wright;* Kommetjie, *Adamson* 2904; S. Peninsula, *Adamson* 1818, 2459. BREDASDORP. Cape Agulhas, *Schlechter* 10567. SWELLENDAM. Potteberg, *Adamson* 3778. RIVERSDALE. Riversdale, *Marloth* 7306. KNYSNA. Robben Hoek, *Fourcade.* HUMANSDORP. Krakakama, *Zeyher* 2658. ALEXANDRIA. Zuurberg, *Drege* 7618. PORT ELIZABETH. Walmer, *Paterson* 1030, 2515. STOCKENSTROOM. Katberg, *Zeyher* 2658. Without exact locality:—*Masson; Pappe.*

var. **Richardiana** Adamson nom. nov. *C. glabrata* Adamson Journ. S. Af. Bot. 6. 50. 1940. *Hydrocotyle glabrata* Rich. Monog. Hydroc. 78. 1820. *H. falcata* E. & Z. Enum. 335. 1837 (p. pte.).

Differs in having ovate, oblong or oblong-lanceolate 3-veined leaves 4—12 mm. wide. *Leaves* thin, not coriaceous. *Umbels* and fruit as in the typical form.

Very distinctive in its more extreme forms but connected by intermediates. The variety has been confused with *C. glabrata* and specimens have had many names attached to them. It is at once separated on the fruit characters.

PIKETBERG. 24 Rivers, *Esterhuysen* 16225. CERES. Visgat, *Esterhuysen* 13441. STELLENBOSCH. Faure, *Penfold;* Simonsberg, *Bond* 1542. CAPE. Table Mt., *Drege; Ecklon & Zeyher* 2174 (*H. plantaginea*)*; Ecklon & Zeyher* (*H. falcata* v. *lanceolata*)*;* Devil's Peak, *Adamson* 2317, 2147; *Bunbury; Bolus* 1118; *Esterhuysen* 13901; *Leighton* 1062; *Levyns* 3626; *Wolley-Dod* 250; Lion's Head, *Ecklon & Zeyher* (*H. falcata* v. *angustifolia*)*;* Rosebank, *Guthrie* 443, 490; Claremont, *Schlechter* 266; Kirstenbosch, *L. Bolus; Compton; Esterhuysen* 554, 15844, 15449, 15749; Wynberg Hill, *C. Norman* 268; Tokai, *Adamson* 4022 (*type*)*; Ecklon* 409; Hout Bay, *Adamson* 2022; Chapman's Peak, *Adamson* 2242; Paulsberg, *Adamson* 2749. CALEDON. Zwartberg, *Zeyher.* RIVERSDALE. Coast, *Muir* 4334. PRINCE ALBERT. Swartberg, *Adamson* 4354, 4364. KNYSNA. Knysna, *Bowie* 11: Heads, *Williamson.* UITENHAGE.

Van Staden's River, *MacOwan* 1141; Addo, *Ecklon & Zeyher* 2174. PORT ELIZABETH. Port Elizabeth, *Paterson* 1031. Without exact locality:—*Alexander; Harvey* 621, 633.

var. **oblonga** Adamson var. nov.

A typo differt caulibus brevioribus decumbentibus, foliis longe petiolatis laminis ovato-oblongis basi plus minusve abrupte attenuatis, petalis villosis, fructibus majoribus in radio breve positis.

Low growing. Stems woody at the base, decumbent, 5—10 cm. long. *Leaves* with 3-veined symmetrically oblong blades, 1—1·7 cm. long, 1—1·5 cm. wide, acute, rather sharply narrowed at the base: petioles 2- or 3-times as long as the blades. *Umbels* on the prostrate shoots, 3-rayed, the rays hairy. *Petals* villous. *Fruit* cordate-orbicular, 4 mm. long, 3·5 mm. wide, with prominent curved ridges, much longer than the acuminate partly scarious bracts. Fruit on a ray not over 1 cm. long.

Very distinctive in habit and leaf shape.

CLANWILLIAM. Cedarberg, Apollo, *Esterhuysen* 18061 (type). WORCESTER. Fonteintjesberg, *Esterhuysen* 16628.

21. **C. debilis** (E. & Z.) Drude in Engler & Prantl Nat. Pflanzf. 3.8. 120. 1898. *Hydrocotyle debilis* E. & Z. Enum. 336. 1837.

A slender more or less prostrate herb, usually rough with short hairs. *Stems* very slender, up to 50 cm. long, the younger with 4 small wings. Lower *leaves* clustered, the upper solitary or in pairs; blades linear. lanceolate, 5—12 cm. long, 3—4 mm. wide, narrowly cuneate at the base, acute with a curved mucro at the tip, with 3—5 projecting veins below. Lower leaves with petioles 2—5 cm. long, the upper very narrow and not obviously petiolate. *Umbels* 3-rayed, the rays very slender, 0·7—1·5 cm. long. *Petals* glabrous, reddish. *Fruit* rounded, 2—3 mm. diam. much longer than the acute bracts. *Mericarps* slightly swollen with a distinct commissural groove, each with a prominent dorsal and very faint lateral ridges, the furrows slightly wrinkled.

Apparently rare and confined to swamps and streamsides in the coastal belt between Port Elizabeth and Riversdale. While well characterized by the 4-angled stems, linear leaves with projecting veins, and the small not much flattened fruits, the species has been much confused. Much of the material so named in collections is not this species.

UITENHAGE. Van Stadensberg, *Ecklon* 2183: *Ecklon & Zeyher* 2176 (type): *Zeyher* 105. MOSSEL BAY. Cloete's Pass, *Adamson* 4337, 4343.

22. **C. stipitata** sp. nov.

Glabra vel glabrescens. *Caules* prostrati. *Folia* fasciculata, lineari-lanceolata, petiolata, coriacea, trinervia. *Umbellae* triradiatae saepissime approximatae, radiis elongatis. *Petala* glabra. *Fructus* orbicularis, distincte stipitatus, apice emarginatus, bracteis multo longior.

A prostrate or sprawling plant in habit much like *C. glabrata.* *Leaves* glabrous or very thinly hairy, petiolate, linear-lanceolate, coriaceous: blades 3—5 cm. long, 2—4 mm. wide, acute, 3-veined: petioles 2—6 cm. long. *Umbels* 3-rayed, usually aggregated, the rays slender, 1—1·5 cm. long, often thinly hairy. *Petals* glabrous. *Fruit* orbicular, 4—5 mm. long and about the same in width, emarginate at the top, on a short thick gynophore 1—2 mm. long. *Bracts* usually glabrous, subacute, about as long as the gynophore.

Mountain slopes in the Zitzikama region.

Allied to *C. glabrata* but with quite different fruit and with much narrower leaves.

UNIONDALE. De Hoek, *Esterhuysen* 16377 (type); Slypsteenberg, *Esterhuysen* 6299; Kamanassie Mts., *Esterhuysen* 16478.

23. **C. Comptonii** sp. nov.

Caules herbacei, ramosissimi, prostrati, subterranei tantum lignosi. *Folia* saepe congesta, ovata, petiolata, ciliata, petiolis hirsutis. *Umbellae* triradiatae aggregatae. *Petala* glabra incurva. *Fructus* ovatus obcordatus, pedicello erecto. *Mericarpia* lateraliter trijuga, vix rugosa. *Bracteae* ciliatae fructu breviores.

In prostrate patches. *Stems* woody below ground, the aerial slender, usually hairy, with many equal branches. *Leaves* clustered, petiolate, blades ovate or elliptical, 3-veined, 1·5—2 cm. long, 3—7 mm. wide, cuneate at the base, acute at the tip, thinly ciliate, not coriaceous: petioles 1—2 cm. long, thinly hairy. *Umbels* often aggregated. *Petals* glabrous, reddish, incurved at the tip. *Fruit* 4—6 mm. long, 3·5—4 mm. wide, flattened, notched at the top, the mericarps with 3 distinct ridges on each face, the furrows almost smooth. *Bracts* acute, ciliate, from half to two-thirds the length of the fruit. Fruit on an erect ray, 0·5—1·25 cm. long.

In habit and leaf like *C. affinis* var. *Richardiana* but quite different in fruit.

KNYSNA. Stony soils on Paardekop near Plettenburg Bay, *Compton* 22668; (*type* in herb. Nat. Bot. Gardens, Kirstenbosch); *Steyn* 706. PORT ELIZABETH. Dunes near Port Elizabeth, *MacOwan* 1118.

24. **C. graminifolia** sp. nov.

Erecta, glabra. *Caules* herbacei. *Folia* linearia, plana, 3-nervia, uperiora sessilia, inferiora in petiolum angustata. *Umbellae* in axillis foliorum superiorum, saepe aggregatae, triradiatae. *Petala* glabra. *Fructus* oblongus, rugosus, bracteis multo longior. *Radius* fructifer brevis erectus.

A slender erect glabrous herb with ascending branches. *Leaves* clustered, flat, linear, 4—6 cm. long, 2·5—3 mm. wide, 3-veined with the side veins close to the margin, the upper leaves sessile, the lower gradually narrowed to a petiole. *Umbels* at the tips of the branches, with 3 equal rays about 4—5 mm. long. *Petals* glabrous. *Fruit* longer than wide, parallel-sided, 4—5 mm. long, 3 mm. wide, flat-topped, much longer than the bracts. *Mericarps* with distinct ridges and slightly wrinkled furrows. Fruit on an erect ray 0·5—1·5 cm. long.

Readily distinguished by the habit, linear flat leaves, and small oblong fruits.

Rather rare in swamps in the eastern districts.

KNYSNA. Knysna, *Levyns* 7867 (type); Barbier's Kraal, *Fourcade* 1577; Buffelshoek, *Hafstrom*. UNIONDALE. Helpmekaar Mt., *Compton* 5186. UITENHAGE. Van Stadensberg, *MacOwan*. PORT ELIZABETH. Parson's Vlei, *F. R. Long* 831. ALBANY. Grahamstown, *MacOwan* 1063. TRANSKEI. Kei Mouth, *Flanagan* 622; Barijaberg, *Baur* 619; Kagatang, *MacOwan* 1141.

Baur 115 from Baziza Mts., and *MacOwan* from Umgoya, Zululand, probably belong to this species but have wider leaves and larger fruits.

25. **C. scabra** Adamson nom. nov. *C. glabrata* var. *acuminata* Adamson Journ. S. Afr. Bot. 6. 53. 1940.

Herbaceous, sprawling or prostrate, rough, varying from densely clothed with short hairs to almost glabrous. *Stems* woody at the base only, the aerial up to 50 cm. long. *Basal leaves* crowded, almost tufted, the upper scattered, often secund: blades rough, oblong-lanceolate to linear-lanceolate, 2—4 cm. long, 2—8 mm. wide, flat or occasionally rolled, 3-veined, the lateral veins often only visible in the lower half, acute or mucronate at the tip: petioles of the lower leaves as long as the blades, of the upper short. *Umbels* 3-rayed, often in groups, often secund and descending on the lateral branches: rays slender, 1—1·5 cm. long, usually hairy. *Male flowers* with 4 hairy bracts, bisexual with 2. *Petals* densely hairy. *Fruit* 2·5—4 mm. long, 2—3 mm. wide, parallel-sided: mericarps with a distinct dorsal but very faint lateral ridges, the furrows smooth. *Bracts* acuminate, varying from half as long as to a little longer than the fruit. Fruit on a slender curved ray up to 5 cm. long.

Distinguished by the small parallel-sided fruit with acuminate bracts. Though originally described as a variety of *C. glabrata*, the differences in habit, leaves, petals, fruit and bracts are such that no very close affinity is indicated.

Two forms of the species occur though they are connected by intermediates, the one which occurs in the more northern areas has leaves with prominent veins and bracts about as long as the fruit, the other which is more southern in distribution has not projecting veins in the leaves and bracts about half as long as the fruit.

Rocky mountain slopes. Not recorded east of Caledon.

VAN RHYNSDORP. Giftberg, *Salter* 7275. CLANWILLIAM. Graafwater, *Acock* 3063. CERES. Cold Bokkeveld Mts., *Adamson* 1064 (type), 1073, 4280, 4286, 4293. TULBAGH. Roodesandberg, *Adamson* 1019, 1026; *Compton* 6552; *Esterhuysen* 6552; Tulbagh Kloof, *Ecklon* 2178 (*H. fusca*) Tulbagh, *Esterhuysen* 16903. PIKETBERG. Porterville, *Esterhuysen* 18106; 24 Rivers, *Esterhuysen* 16621. WORCESTER. Wabooms River, *Esterhuysen* 8947. PAARL. Seven Sisters, *Esterhuysen* 9040; Witte River Valley, *Adamson* 4392, 4393; Du Toit's Kloof Pass, *Esterhuysen* 15702, 15818; Donker Kloof, *Esterhuysen;* Berg River Valley, *Adamson* 4406. STELLENBOSCH. Jonkershoek, *Adamson* 3999, 4003, 4070, 4080, 4231, 4234, 4236. CAPE. Lion's Head, *Zeyher* (*H. plantaginea*); *Esterhuysen* 15760, 15761; Kirstenbosch, *Esterhuysen* 15451, 15843; Wynberg, *Esterhuysen* 15748, 15847. CALEDON. Houwhoek, *Adamson* 4245; Hawston *Adamson* 4251; Babylon's Tower, *Esterhuysen* 15843. Without exact locality:—*Acock* 4634; *Harvey*.

26. **C. lasiophylla** Adamson sp. nov.

Tota pilis albis mollibus tecta. *Caules* elongati procumbentes ramosi non radicantes. *Folia* saepissime fasciculata petiolata, laminis trinerviis ovatis vel oblongis acutis basi subtruncatis vel late cuneatis. *Petioli* laminis longiores. *Umbellae* triradiatae, radio fructifero vix elongato. *Fructus* ovatus bracteis pilosis acuminatis brevior vel aequilongus.

Covered all over with short soft white almost velvetty hairs. *Stems* elongate, sprawling or prostrate, slender, up to 2 m. long, branched, not rooting at the nodes. *Leaves* petiolate, most often in groups, blades oblong or ovate, 1·5—3 cm. long, 0·8—1·3 cm. wide, acute and often mucronate at the tip, widely cuneate or subtruncate at the base, 3-veined; petioles of the lower leaves 2- or 3-times as long as the blades, not longer than the blades in the upper. *Umbels* 3-rayed, the rays 3—5 mm. long, not extending at the fruiting stage. *Petals* hairy, at least in the middle. *Fruit* 3·5 mm. long, 2—3 mm. wide, parallel-sided, often red-brown, smooth, with very faint ridges. *Bracts* pilose, acuminate, longer than or as long as the fruit.

On sand under bushes in the Cedarberg ranges.

In collections this has been confused with *C. villosa* and with hairy forms of *C. glabrata*.

CLANWILLIAM. Pakhuis Pass, *Adamson* 4261 (type), 4262: Wuppertal, *Bolus* 9011; *Compton* 4748; Krakadouw Poort, *Esterhuysen* 12243; Hex River, *Pearson* 52697; Olifants River, *Esterhuysen* 17931. CERES. Elands Kloof, *Levyns* 4783.

Specimens collected on hills near Brand Vlei, Worcester (*Rehmann* 2378, 5166; *Esterhuysen* 1925) may belong to this species but have more cuneate leaves and rounded fruits longer than the bracts.

27. **C. pottebergensis** Adamson sp. nov.

Glabra. *Caules* suberecti basi lignosi. *Folia* dense fasciculata fasciculis distantibus, plana, linearia, 1-nervia, coriacea. *Umbellae* aggregatae triradiatae. *Petala* glabra. *Fructus* compressus, obcordatus vel orbicularis bracteis acutis longior, jugis parvis valleculis subrugosis.

A suberect or sprawling glabrous plant. *Stems* woody at least at the base. *Leaves* crowded with long internodes between the clusters, strap-shaped or linear-lanceolate, 2—7·5 cm. long, 3—5 mm. wide or rarely 7 mm., leathery, brown, 1-veined, acute or rounded at the tip, narrowed at the base to a petiole 1—2 cm. long. Upper leaves smaller and with shorter petioles. *Umbels* 3-rayed with male and bisexual flowers, with male flowers only, or 1-rayed with a bisexual flower, the different kinds usually on the same plant but some plants with male flowers only. *Rays* 4—5 mm. long. *Petals* glabrous, white. *Fruit* 3·5—4 mm. long and wide, often emarginate at the top, slightly longer than the acute bracts. *Mericarps* with very small ridges and slightly wrinkled furrows. Fruit on an erect ray not over 0·5 cm. long.

Very distinctive in habit.

SWELLENDAM. Potteberg, *Adamson* 4306 (*type*), 4308, 4310, UNIONDALE. Zitzikama Mts., *Esterhuysen* 4771, 16771.

28. **C. sessilis** Adamson sp. nov.

Caules procumbentes basi lignosi. *Folia* numerosa glabra oblanceolata vel anguste oblonga, acuta, uninervia, integra vel raro apice dentata, coriacea vel subcarnosa, basi in petiolum sensim attenuata. *Umbellae* andro-dioicae, masculae 4—6 radiatae floribus ternatis, bracteis acutis ciliatis, fertiles uniflorae radio breve erecto. *Petala* glabra. *Fructus* depresso-rotundatus, compressus, latior quam longus, mercarpiis jugis distinctis curvatis. *Bracteae* fructu paulo breviores.

In small tufts with prostrate stems often buried in the soil but not rooting at the nodes. *Leaves* 2—6 cm. long, 2—4 mm. wide, glabrous oblanceolate or narrow-oblong, 1-veined, acute, entire or occasionally a few with 1 or 2 teeth at the tip, coriaceous or somewhat succulent, often glaucous, gradually narrowed at the base to a short petiole. *Umbels* aggregated, the male and bisexual on separate plants: male with 4—6 rays each with 3 flowers though commonly one is abortive: bisexual flowers solitary on a short erect ray 2—3 mm. long. *Petals* glabrous, large, white. *Fruit* compressed, wider than long, emarginate at the top, 3—4 mm. long, 4—5 mm. wide, dark green, slightly longer than the acute bracts. *Mericarps* with rather prominent curved ridges. Fruit ray short or occasionally elongating to 4—6 mm.

Widely spread in open places on mountains.

Distinguished by the low growing habit, small glabrous 1-veined leaves, many-rayed male flowers, and the fruits on very short rays. The leaves may be as thick as wide.

CLANWILLIAM. Cedarbergen, *Esterhuysen* 7581. CERES. Valsch Gat Kloof, *Esterhuysen* 1576. WORCESTER. Roodeberg, *Compton* 8400; Prospect Peak, *Esterhuysen* 15928; Waaihoek, *Esterhuysen* 18196. RIVERSDALE. Langeberg, *Marloth* 5187. MOSSEL BAY. Robinson Pass, *Adamson* 4350 (type), 4348. UNIONDALE. Outeniqua Mts., *Esterhuysen* 13313; Kouga Peak, *Esterhuysen* 16277.

The following probably belong to this species but are without fruit:—

CERES. Olifants River Mts., *Esterhuysen* 13495. WORCESTER. Matroosberg, *Wilman* 14198. CALEDON. Babylon's Tower, *Esterhuysen* 4997. BREDASDORP. Appelskraal, *Stokoe* 9430. RIVERSDALE. Garcias Pass, *Esterhuysen* 17326; *Thorne*. MOSSEL BAY. Robinson Pass, *Salter* 3265; Gouritz River, *Ecklon & Zeyher* (as *H. montana*). PRINCE ALBERT. Swartberg Pass, *Bolus* 11518. GEORGE. George, *Prior;* Postberg, *Burchell* 5938; Cradockberg, *Galpin* 4090. FORT BEAUFORT. Katberg, *S. M. Young* 15223.

29. **C. fusca** (E. & Z.) Adamson comb. nov. *Hydrocotyle fusca* E. & Z. Enum. 336. 1837 (emend.).

More or less tufted but often with elongated semierect or sprawling branches. Laxly hirsute all over or glabrescent. *Leaves* linear or oblanceolate, 1—3 cm. long, 2—3 occasionally 5 mm. wide, often rolled, usually much crowded in fascicles, gradually narrowed at the base to a petiole. *Umbels* crowded together, 3-rayed with a bisexual flower or with male flowers only, or 1-rayed with a bisexual flower, the last on separate plants. *Rays* of the male flowers 2—4 mm. long. *Petals* very hairy. *Fruit* about 4 mm. long, and about as wide, not compressed, 2—4 mm. thick, obtusely conical or rounded, usually emarginate at the tip, wrinkled or dotted but with very faint ridges. *Bracts* 4, linear, about as long as the fruit but not appressed to it. Fruit on an erect or spreading ray 0·4—1·5 cm. long.

Distinguished from all other species by the conical not compressed fruit with long linear bracts. Very variable in the degree of hairiness and in the width of the leaves: plants from dry situations have apparently terete tightly rolled leaves.

The specimens of the type number (*Ecklon & Zeyher* 2178) are poor and incomplete but do represent this species. The original description is incorrect about the number of rays in the umbel.

VAN RHYNSDORP. Giftberg, *E. P. Phillips.* CLANWILLIAM. Pakhuis Pass, *Adamson* 4263; *Esterhuysen* 3418; *Levyns* 9447; Cedarberg, *Esterhuysen* 18015, 18046, 18159; Algeria, *Esterhuysen* 18175; *Salter* 7578 ♂; *Lewis* 22220 ♂; Olifants River, *Esterhuysen* 17876. CERES. Cold Bokkeveld Mts., *Adamson* 1072A, 4115, 4120, 4123, 4267, 4268, 4282, 4285; Schurfteberg, *Esterhuysen* 17380; Ceres Peak, *Esterhuysen* 17530. TULBAGH. Tulbagh Kloof, *Ecklon & Zeyher* 2178 (*type*). PIKETBERG. Piketberg, *Compton* 3634; Porterville, *Esterhuysen* 16139. WORCESTER. Hex River Mts., *Esterhuysen* 15931.

30. **C. didymocarpa** Adamson sp. nov.

Subcaespitosa, glabra vel glabrescens. *Caules* lignosi ramis brevibus decumbentibus congestis. *Folia* numerosa lanceolata petiolata uninervia integra vel rarissime apice dentata. *Umbellae* triradiatae foliis multo breviores. *Petala* glabra. *Fructus* didymus, basi abrupte angustata, bracteis duplo longior, mercarpiis subsphaericis reticulatis.

Almost glabrous. In low tufts. *Leaves* crowded, petiolate: blades lanceolate, 1-veined, 1·5—2 cm. long, 3—5 mm. wide, entire or a few with 1—3 teeth near the tip, gradually narrowed at the base: petiole as long as the blade in the lower leaves, shorter in the upper. *Umbels* 3-rayed, among the leaves. *Petals* glabrous. *Fruit* on a short straight ray, broader than long, 4—4·5 mm. wide, 3 mm. long, the mericarps almost spherical with a depressed commissure, the ridges small, the furrows reticulate. *Bracts* about half as long as the fruit.

Distinguished from all other species by the fruit.

UNIONDALE. Mts. near Joubertina, *Esterhuysen* 16754 (*type*).

31. **C. rupestris** (E. & Z.) Adamson Journ. S. Afr. Bot. 15. 95. 1950. *Hydrocotyle rupestris* E. & Z. Enum. 334. 1837. *H. arbuscula* Schlechter Bot. Jahrb. 27. 172. 1890. *C. arbuscula* Domin Bot. Jahrb. 41. 168. 1908.

An erect woody shrublet, 12—25 cm. high, with few ascending branches. *Stems* bare below, leafy above. *Leaves* crowded, oblanceolate, 2—6 cm. long, 0·3—0·8 cm. wide, acute and usually mucronate at the tip, gradually narrowed from near the tip to the base but not obviously petiolate, leathery, often revolute, glabrous except for curled hairs on the edge of the sheath. *Umbels* axillary, or on short lateral branches, 3-rayed, some with male flowers only. *Rays* of the male flowers 4—5 mm. long, of the bisexual 2—3 mm. *Male flowers* with 4 acuminate bracts, bisexual with 2. *Bracts* ciliate, those of the bisexual flowers 5—6 mm. long and about 2—3 mm. wide at the base, enclosing the flower. *Fruit* rounded, about 4 mm. long and wide, flat-topped, rather thick, shorter than but as wide as or wider than the bracts. *Mericarps* with very thin curved ridges and wide slightly wrinkled furrows.

Endemic and rare in damp situations at low altitudes in the Caledon division.

A very distinctive species not closely related to any other. It is retained in the series *Glabratae* for convenience but might well be placed in a separate series. *C. arbuscula* has no distinguishing features.

CALEDON. Klein River, *Zeyher; Zeyher* 2667 (type); *Ecklon & Zeyher* 2170; Bot River, *Schlechter* 9444 (*H. arbuscula*); *Middlemann.*

Series 6. **Virgatae.**

Caules erecti vel procumbentes, basi lignosi. *Folia* teretia, semiteretia vel linearia, saepe fasciculata, nervis obscuris. *Umbellae* saepe aggregatae, andro-monoicae vel andro-dioicae.

Separated from series *Glabratae* on the features of the leaf.

Key to the Species.

1. Leaves or some of them flat or revolute.
  2. Erect woody plants with forked branching: fruit longer than the bracts .. .. 33. *linifolia*
  2. Diffuse herbs, woody at the base only.
    3. Fruit rounded, shorter than the bracts .. .. 37. *restioides*
    3. Fruit oblong, longer than the bracts .. .. .. 36. *recticarpa*
1. Leaves terete, usually grooved.
  4. Densely tufted: fruit ray swollen at the top; fruit wider than long .. .. 38. *caespitosa*
  4. Not tufted; shoots elongated: fruit ray not swollen at the top.
    5. Fruit ray elongated, 1 cm. or more long.
      6. Fruit ray slender: fruit longer than the bracts.
        7. Diffuse: leaves firm: fruit 3·5—4 mm. long, usually longer than wide .. .. .. 32. *virgata*
        7. Prostrate: leaves very slender: fruit not over 3 mm. long, wider than long .. .. 34. *stenophylla*
      6. Fruit ray stout: fruit 4—5 mm. diam., shorter than the bracts .. .. 37. *restioides*
    5. Fruit ray short, not over 0·5 cm. long.
      8. Fruit rounded, as wide as long, with prominent ridges .. .. 37. *restioides*
      8. Fruit oblong, longer than wide.
        9. Fruit wedge-shaped, narrowed to the base, the ridges faint .. .. 32. *virgata* var. *congesta*
        9. Fruit parallel-sided, with a prominent stylopodium: ridges prominent .. .. .. 36. *recticarpa*

32. **C. virgata** (L.f.) Drude in Engler & Prantl Nat. Pflanzf. 3.8. 120.

1898. *Hydrocotyle virgata* L.f. Supp. Pl. 176. 1781. *H. lanuginosa* E. & Z. Enum. 337. 1837 (p. pte.). *H. filicaulis* E. & Z. l.c. 338. *H. trichophylla* E. & Z. l.c. 338. (p. pte.).

Stems many from the root, erect, sprawling or semiprocumbent, woody at the base only, branched especially at the base, up to 80 cm. long, glabrous or hairy. *Leaves* terete with a small groove, stout or slender, the lower crowded, up to 15 cm. long, the upper shorter, scattered or in groups of 2 or 3. *Sheaths* with a narrow membranous edge, usually woolly inside. *Umbels* in the upper axils, solitary or in groups, 3-, 4- or 6-rayed, the rays slender, 0·5—1·5 cm. long, often hairy. *Umbels* usually all alike or the uppermost with male flowers only. *Petals* glabrous, white or brownish, often large. *Fruit* flattened, usually longer than wide, 3·5—4·5 mm. long, 3—4 mm. wide, flat-topped or indented, at least twice as long as the bracts. *Mericarps* with faint or slightly prominent almost straight ridges and smooth or slightly wrinkled furrows. *Bracts* acute or acuminate. Fruit ray up to 2·5 cm. long, usually straight and ascending.

Often brown in colour. Very variable in size, hairiness, and in the numbers of leaves. A stout form with large white petals, smooth fruits with faint ridges and acuminate bracts, may be a distinct variety. It is found in the Caledon Division.

Frequent on bushy mountain slopes along the south coast. Absent from the exposed upper parts of the mountains.

PIKETBERG. Porterville, *Edwards* 16149; *Esterhuysen* 16116. TULBAGH. Winterhoek, *Bolus* 5057; Waterfall, *Ecklon & Zeyher* 2185 (*H. trichophylla*). CERES. Castle Rocks, *Thode* A.2245. WORCESTER. Du Toit's Kloof, *Esterhuysen* 15676; Bain's Kloof, *Compton* 18626. CALEDON. Genadendal, *Pappe;* Houwhoek, *Adamson* 4424; *Zeyher* 2668; Paardeberg, *Adamson* 4181, 4200, 4208, 4378; Palmiet River, *Compton* 14102; *Levyns* 3843; *Stokoe* 8808, 8992; Kleinmond, *Marloth* 14105. BREDASDORP. Bredasdorp, *Galpin.* ROBERTSON. McGregor, *Adamson* 4449. SWELLENDAM. Swellendam, *O. Kuntze;* Grootvadersbosch, *Adamson* 3796, 3800, 3800A; *Esterhuysen* 10507. RIVERSDALE. Garcia's Pass, *C. A. Smith* 2468; Aasvogelberg, *Muir* 891; Tradouwberg, *Bowie.* MOSSEL BAY. Cloete's Pass, *Zinn*; Robinson Pass, *Adamson* 4346, 4347. GEORGE. Montagu Pass, *Compton* 7577; *Hutchinson* 1223; Outeniqua Mts., *Prior;* Hoogekraal, *Hutchinson* 1300; Barbier's Kraal, *Fourcade* 1577. LADISMITH. Seven Weeks Poort, *Andreae* 1312; *Compton* 4236; *Levyns* 2453; Swartberg, *Esterhuysen* 13944. PRINCE ALBERT. Swartberg Pass, *Barker* 5456; *Bolus* 10519; *Pocock* S.117; *Stokoe* 8809, 9056; *Wall.* KNYSNA. Homtini Pass, *Galpin* 4087; *Gillett* 4545; Concordia, *J. D. Keet* 573, 2877; The Glebe, *Galpin* 4088; Gouna Road, *Levyns* 7850; Lange Valle, *Burchell* 5702; Portland, *Rehmann* 372;

Paardekop, *Burchell* 5162; Kayman's Gat, *Burchell* 5798; Swart Riv., *Fourcade* 1577; Eiland Kop, *J. Phillips* 27. UNIONDALE. Avontuur, *Fries, Norlindh & Weimarck* 1645; Joubertina, *Esterhuysen* 10618; Mannetjesberg, *Esterhuysen* 4708; Zitzikama Mts., *Esterhuysen* 10636. HUMANSDORP. Coldstream, *Galpin* 9587; Riet Vlei, *Esterhuysen* 6614; Kouga Hills, *Esterhuysen* 6662; Loerie Plantn. *Dix* 16; Zuur Anysberg, *Fourcade;* Witelsbosch, *Fourcade* 291; Clarkson, *Thode* A.847. PORT ELIZABETH. Port Elizabeth, *Fries, Norlindh & Weimarck* 1148. UITENHAGE. Van Staden's Riv., *Ecklon & Zeyher* 2183; *F. R. Long* 252, 667; *Paterson* 1920; *Schlechter* 6071; *G. C. Theron* 654; Vanstadensberg, *Drege* 7621a; *MacOwan* 1063; Uitenhage, *Zeyher* 18; Swartkops Riv., *Zeyher* 2668; Melkhoutstroom, *R. Story* 2615; Otterford, *Rodin* 1117; Witteklip, *Holland* 3585; Springfield, *Paterson* 1920; Addo, *Ecklon & Zeyher;* Stones Hill, *Schonland* 197. ALEXANDRIA. Zuurberg, *Drege* 7620; *Rennie* 457. ALBANY. Grahamstown, *F. A. Rogers* 27663; *MacOwan* 1063; Highlands, *Dyer* 2226; Thescomb, *Paterson* 1920; Collingham, *L. Britten* 1966, 5100; Hofman's Bush, *L. Britten* 1018. Without exact locality:—*Ecklon & Zeyher* (*H. filicaulis*); *Ecklon & Zeyher* 2184; *Masson; Prior; Thunberg; Zeyher.*

var. **gracilescens** Domin Fedde Repert. 4. 300. 1907.

Low growing. *Stems* woody, much branched, short. *Leaves* crowded, very slender, 2—3 cm. long. *Umbels* crowded, partly dioecious: rays at flowering time 3—4 mm. long, but the fruiting finally 1—1·5 cm. long, often curved or deflexed. *Fruit* 3·5—4 mm. long, 3—3·5 mm. wide, almost smooth, much longer than the bracts.

Rocky slopes in the western and northern districts. Very distinctive in habit. Specimens have often been named *H. filicaulis* or *H. trichophylla.* NAMAQUALAND. Riet Kloof Mts., *Pearson* 5723. CLANWILLIAM. Pakhuis Pass, *Esterhuysen* 3419. CERES. Cold Bokkeveld Mts., *Adamson* 1072, 1070; Gydoberg, *Adamson* 3721A; Gideonkop, *Esterhuysen* 13878?; Slab Peak, *Esterhuysen* 6172. TULBAGH. Roodesandberg, *Adamson* 1018. WORCESTER. Fonteintjesberg, *Esterhuysen* 10953. CAPE. Karbonkelberg, *Adamson* 1206. Without exact locality:—*Harvey* 630.

var. **congesta** Adamson var. nov.

A typo differt:—foliis superioribus tenerrimis congestis, umbellis aggregatis, radiis plus minusve dense pilosis, fructibus oblongis bracteis triplo longioribus in radiis perbrevibus positis.

Like *C. virgata* but with crowded very slender leaves 1—2·5 cm. long at the tips of the stems. *Umbels* crowded, the rays usually densely hairy. *Fruit* 4 mm. long, oblong, parallel-sided, not over 3 mm. wide, three times as long as the bracts, on a ray 3—5 mm. long. Either hairy or glabrous except for the leaf axils and umbels.

SWELLENDAM. Tradouw Pass, *Acock* 2218; *Adamson* 3773 (type); 4021; *Drege* 7626; *Levyns* 590; *Marloth* 12170, 12171; *Salter* 6316; *Stokoe*, Swellendam, *Acock* 15440; Grootvadersbosch, *Esterhuysen* 10389; RIVERSDALE. Garcia's Pass, *Adamson* 4367, 4373; *E. P. Phillips* 350. *C. A. Smith* 2768; Hermanshoek, *Muir* 395; Aasvogelberg, *Muir* 891; Langeberg, *Schlechter* 1735. MOSSEL BAY. Cloete's Pass, *Stokoe*. GEORGE. George, *Prior;* Montagu Pass, *Hutchinson* 1223. UNIONDALE. Lauterwater, *Esterhuysen* 4622. Without exact locality:—*Ecklon* 2182.

E. P. Phillips 9180 from Seven Weeks Poort is probably this variety but is without fruit.

33. **C. linifolia** (L.f.) Drude in Engler & Prantl Nat. Pflanzf. 3. 8. 120; 1898 (quoted as "*linifolia* (Thunb.)". *Hydrocotyle linifolia* L.f. Supp. Pl. 176. 1781. *C. glabrata* var. *linifolia* f. *rigescens* Domin Bot. Jahrb. 41. 168. *H. Centella* var. *linifolia* s-vars. *rigida* & *verticillata* 1908. Sond. Fl. Cap. 2. 532. 1862.

Rigid erect woody plant, up to 50 cm. high, with fork-like branches. Glabrous, glabrescent or pubescent, often glaucous. *Leaves* clustered, rigid, 2—5 cm. long, the basal up to 8 cm., linear, 1—4 mm. wide, flat, revolute or the upper terete, often rough. *Umbels* usually dioecious, male 3—6-rayed, with rays 4—6 mm. long, each with 2 or 3 flowers; bisexual flowers solitary on a ray 2—5 mm. long. *Umbels* with both male and bisexual flowers may occur on plants with otherwise male flowers. Petals glabrous, white or pink. *Fruit* rounded or slightly longer than wide, 2·5—5 mm. diam., dark green, the mericarps with distinct curved ridges and much wrinkled furrows. *Bracts* acute or acuminate, much longer than the flowers, shorter than the fruit. Fruit ray erect or spreading, 0·5—1 cm. long.

Variable in leaf and in hairiness. Allied to and often confused with *C. virgata*. Distinguished by the rigid habit, flat leaves, unisexual umbels, and larger fruits with more prominent ridges. In the absence of flowers the species are not always separable.

There has been a good deal of confusion in the application of the name *linifolia*. It has been used for *C. affinis* and other narrow-leaved plants. The original description is not satisfactory and gives only features of little importance. There is however no doubt about the original specimens in Thunberg's collection.

Dry rocky mountain slopes. Especially abundant on mountains at the margins of the karroo area.

NAMAQUALAND. Groenrivier, *Drege* 7622a. VAN RHYNSDORP. Giftberg, *Drege* 7622; *E. P. Phillips* 7612. CLANWILLIAM. Cedarberg, *Bolus* 9012; *Ecklon & Zeyher* 2180; *Zeyher* 727 (type of *H. rigescens*); Ezelbank, *Drege* 7624a; Wupperthal, *Drege* 7623; Wolfberg, *Esterhuysen* 18099; Tafelberg, *Esterhuysen* 18167. Olifants River, *Stephens* 6860, 7121. PIKETBERG. 24 Rivers, *Zeyher*. CERES. Witzenberg, *Andreae* 187 (♂). TULBAGH. Winterhoek, *E. P. Phillips* 11209; Roodesandberg, *Adamson* 1031; *Levyns* 5716. WORCESTER. Krom River Peak, *Esterhuysen* 9401 (♂). PAARL. Haalhoek Sneeuwkop, *Esterhuysen* 13520 (♂). ROBERTSON. Sondereinde Mts., *Levyns* 5454, 9202. MONTAGU. Baden, *Compton* 18435. LADISMITH. Ladismith, *Levyns* 4438, 9116; Touwsberg, *Levyns* 7469, 9096; Roodeberg, *Adamson* 3690; *Levyns* 6094. MOSSEL BAY. Gouritz River, *Ecklon & Zeyher* 2182 (*H. lanuginosa*). ALEXANDRIA. Zuurberg, *Drege* 7620. Without exact locality:—*Ecklon* 218 (*H. lanuginosa*), 2179; *Zeyher* 742 (♂).

The specimens collected by Drege and given the M.S. name *H. linearis* by Meyer appear to be a form of this species with very short leaves.

var. **depressa** Adamson var. nov.

Humilis, depressa. *Folia* congesta, plana, linearia, brevia, scaberrima. *Fructus* in radio elongato positus.

A low-growing almost tufted woody plant. *Leaves* crowded, flat, not over 2 cm. long, very rough. *Fruit* on a long slender ray 1—2 cm. long.

CERES. Olifants River Mts., *Esterhuysen* 13496. WORCESTER. Bonteberg, *Esterhuysen* 3708, 3741. LAINGSBURG. Witteberg, *Adamson* (s.n.) (type); *Compton* 2540, 2963, 3564, 13968.

34. **C. stenophylla** Adamson sp. nov.

Caules tenuissimi prostrati ramosissimi ramis intricatis. *Folia* filiformia saepissime glabra, marginibus vaginarum non-scariosis. *Umbellae* triradiatae, floribus parvis. *Fructus* orbicularis, parvus, bracteis multo longior, jugis prominentibus, valleculis rugosis. *Radius* fructifer tenuis elongatus.

A low-growing much branched herb forming patches or tangles. Usually glabrous except for a few hairs in the leaf axils. *Stems* very slender, up to 40 cm. long, the branches with long internodes. *Leaves* thread-like, soft, dark green, 2—6 cm. long, the sheaths small, brown, with no membranous margin. *Umbels* 3-rayed, often grouped: rays slender, glabrous: flowers very small. *Petals* glabrous. *Fruit* rounded, as wide as long or slightly wider, 2·5—3·5 mm. long, 3—3·5 mm. wide, much longer than the minute membrane-edged bracts. *Mericarps* with rather prominent ridges and wrinkled furrows. Fruit on a very slender ray about 1 cm. long.

Distinguished by the habit, very slender leaves and very small rounded fruits. Apparently confined to rocks on mountains in the Swellendam region.

SWELLENDAM. Swellendam Mts., *Esterhuysen* 4811; Potteberg, *Adamson* 3779, 4302 (type), 4304: Tradouw Pass, *Barnard*; Langeberg above Heidelberg, *Esterhuysen* 18269.

35. **C. macrocarpa** (Rich.) Adamson Journ. S. Afr. Bot. 6. 54. 1940. *H. macrocarpa* Rich. Monog. Hydroc. 80. t.67 f.40. 1820. *H. virgata* var. *macrocarpa* DC. Prodr. 4. 69. 1830. *C. virgata* var. *macrocarpa* Domin Bot. Jahrb. 41. 167. 1908. *H. alpina* E. & Z. enum. 334. 1837.

Erect or semierect, often in bunches, with many ascending branches from the woody base. Glabrous or less commonly hairy. *Stems* only persistent at the base. *Leaves* terete, grooved, usually in groups, 4—10 cm. long, all alike, the upper shorter but not more slender. *Sheaths* hairy, without a membranous edge. Plants of three kinds: with male and bisexual flowers in the umbel, with male flowers only, and with bisexual flowers only. *Umbels* with male flowers 3—6 rayed, most commonly 4 or 6, but umbels with bisexual flowers only 1-rayed. *Rays* 3—8 mm. long, much longer than the acuminate involucre. Male flowers in groups of three though 1 or 2 usually abortive, bisexual flowers solitary. *Petals* glabrous, often reddish, with a narrow translucent margin. *Fruit* rounded in outline, 5—6 mm. long, 4·5—5·5 mm. wide, green or purple, with prominent curved ridges and very slightly wrinkled furrows. *Bracts* acuminate, usually hairy, as long as or half the length of the fruit. Fruit ray short, 3—5 mm., stout, shorter than the rays with male flowers.

Rather variable in size, form, and hairiness. The plants described as *H. alpina* are merely rather slender forms of this species.

Heathy soils on flats and mountains throughout the coastal belt but most common in the south-west.

PIKETBERG. Porterville, *Edwards* 16149 (♂). TULBAGH. Winterhoek, *Ecklon* 2181; *Marloth* 1638. WORCESTER. Orchard, *Esterhuysen* 10882; Worcester, *Ecklon & Zeyher* 1.1; Onklaarberg, *Stokoe* 11686; Du Toit's Kloof, *Drege* 1839; Tyson 915. PAARL. Wemmershoek, *Andreae* 734; Du Toit's Kloof Pass, *Adamson* 4332. STELLENBOSCH. Hottentots Holland, *Ecklon & Zeyher* 2181; *Bowie; Prior;* Sir Lowry's Pass, *Adamson* 4041, 4156; *Leighton* 827; *Guthrie & Page; Parker* 4268; Gordon's Bay, *Marloth* 10006. CAPE. Doornhoogte, *Ecklon & Zeyher;* Table Mt., *Drege (H. alpina); Ecklon & Zeyher* 2171 (*H. alpina*)*; Mundt; Pappe; Prior; Zeyher* 4901; Lion's Head, *Ecklon* 7; Camps Bay, *Adamson* 697; *Barker* 536; *Esterhuysen* 12840; *Hafstrom;* Chapman's Peak, *Adamson* 2252A; Mowbray, *Guthrie* 359; Camp Ground, *Salter* 8953; *F. M. Isaac;*

Wallich; Newlands, *Burchell* 464; Kenilworth, *Adamson* 579, 1197; Wynberg, *Ecklon; E. Kensit;* Constantia Nek, *Salter* 1172; Vlaggenberg, *Schlechter* 222; Constantiaberg, *Wolley-Dod* 655; Diep River, *Marloth* 7305; Muizenberg, *Prior;* Simonstown, *Adamson* 2343; *Wright;* Klaver Valley, *Adamson* 1335, 1340, 1347; *Wolley-Dod* 1982, 2081. CALEDON. Steenbras, *Adamson* 4327, 4328, 4329; *Parker* 4017; Koel Bay, *Adamson* 4027, 4029; Sir Lowry's Pass, *Acock* 2572; *Hafstrom; Salter* 1830; Hangklip, *Compton* 17587; Palmiet River, *Esterhuysen* 12609; Paardeberg, *Stokoe;* Bot River, *Adamson* 4230; Houwhoek, *Adamson* 4248; *Bowie; Zeyher* 2668; Caledon, *O. Kuntze;* Genadendal, *Pappe; Zeyher;* Arieskraal, *Compton* 16486; River Sondereinde, *Burchell* 7563; *Leipoldt* 16236. BREDASDORP. Bredasdorp, *Galpin* 11326; Elands Kloof Mts., *Adamson* 4323. ROBERTSON. Boesmanskloof Pass, *Esterhuysen* 4483. SWELLENDAM. Swellendam, *Mundt;* Zuurbraak, *Thode* A2329. LADISMITH. Seven Weeks Poort, *Stokoe* 1943. RIVERSDALE. Langeberg, *Schlechter* 1735. PRINCE ALBERT. Swartberg, *Adamson* 4355, 4358, 4362; *Esterhuysen* 4530; *Stokoe* 9059. HUMANSDORP. Witelsbosch, *Fourcade* 792. Without exact locality:—*Harvey* 623, 628, 631, 636; *Masson; Wallich.*

var. **saxatilis** Adamson var. nov.

A typo differt:—caulibus lignosis, foliis brevibus, subrigidis pungentibus, umbellis foliis muto brevioribus, fructibus minoribus bracteis triplo longioribus.

A diffuse woody plant. *Leaves* short, 2—4 cm. long, grouped, rather rigid, pungent; sheaths membrane-edged. *Umbels* all alike: rays 5—6 mm. long. *Fruit* 4 mm. diam., much longer than the bracts, on a short ray, about 3 mm.

Rocky places on dry mountain slopes.

RIVERSDALE. N. entrance to Garcia's Pass, *Adamson* 4368 (type). CERES. Gydoberg, *Adamson* 3721.

36. **C. recticarpa** Adamson sp. nov.

C. macrocarpae affinis sed differt caulibus tenuibus brevioribus ex base lignoso, foliis brevioribus apice complanatis, umbellis omnibus simillibus, fructibus oblongis jugis rectis prominentibus, apice stylopodio biconico coronatis.

In erect bunches 15—20 cm. high, from a stout prostrate woody stem, up to 8 mm. diam. *Leaves* slender terete but often flattened at the tip, glabrous, the lower 3—5 cm. long, the upper shorter. *Umbels* all alike, 3- or 4-rayed: rays with male flowers 1—1·5 cm. long, that with the fruit 2—4 mm. long. *Male flowers* in groups of 2 or 3. *Petals* glabrous, red or purplish. *Fruit* brown or purple, oblong, parallel-sided, about 4 mm. long and 2·5 mm. wide, the stylopodium forming two purple cones almost 1 mm. high: mericarps with prominent straight ridges. *Bracts* acuminate, partly scarious, not over half the length of the fruit.

CLANWILLIAM. Cedarberg, Pienaar's Vlakte, Driehoek, *Esterhuysen* 18093 (*type*).

Much smaller than *C. macrocarpa* and quite different in fruit.

37. **C. restioides** Adamson sp. nov.

Caules ramosissimi, basi tantum lignosi, primo villosi sed glabrescentes. *Folia* subrigida plana vel saepissime revoluta, linearia; vaginis latis tandem castaneis, intus villosis. *Flores* andro-dioici, masculi in umbellis triradiatis villosis, fertiles solitarii. *Fructus* orbicularis bracteis acuminatis brevior, jugis prominentibus, valleculis rugosis, pedunculo subrigido breve vel saepe elongato.

Diffuse in tufts or bunches. *Stems* erect or occasionally prostrate with erect branches, woody at the base, much branched, the young parts hairy but the older glabrescent. *Leaves* usually grouped, up to 10 cm. long, very narrow, 1—4 mm. wide, flat, linear-spathulate, very often revolute and apparently terete; sheaths 3—5 mm. long, green at first but soon brown, ciliate, hairy inside, with obtuse auricles at the top. *Flowers* dioecious, male umbels and those with bisexual flowers on separate plants. *Male umbels* 3-rayed, the rays 4—7 mm. long, densely villous: flowers in groups of three, with 4 acuminate bracts. *Bisexual flowers* solitary, usually with 2 bracts. *Petals* densely hairy. *Fruit* rounded, 4—5 mm. diam., usually emarginate at the top, shorter than the acuminate bracts. *Mericarps* with prominent curved ridges and furrows wrinkled or pitted. *Fruit* on a stout ray 0·4—1·2 cm. long.

On heathy soils along with Restionaceae and looking superficially like them. Most abundant on the mountains between Bain's Kloof and Du Toit's Kloof.

PAARL. Bain's Kloof, *Adamson* 4384, 4394; *Gillett* 801; Witte River, *Adamson* 4239 (type ♂), 4240 (type ♀), 4238, 4240, 4241, 4381; *Esterhuysen* 12471; Du Toit's Kloof Pass, *Esterhuysen* 12340; Franschhoek Pass, *Compton* 8157 (♂); *Esterhuysen* 2818. WORCESTER. Baviaan's Kloof, *Adamson* 4386; *Leighton* 2163; Witteberg, *Esterhuysen* 16519; Prospect Peak, *Esterhuysen* 15930; Du Toit's Kloof, *Drege* (*H. virgata* L.f.b.). CERES. Ceres Peak, *Esterhuysen* 17531. CLANWILLIAM. Cedarberg, *Esterhuysen* 7464. ROBERTSON. Sondereinde Mts., *Adamson* 4433, 4435.

38. **C. caespitosa** Adamson sp. nov.

Compacta, caespitosa. *Caules* lignosi ramis numerosis brevibus.

Folia congesta erect teretia glabra vel sparse pilosa. *Umbellae* foliis multo breviores. *Fructus* complanatus, obcordatus apice emarginatus, in pedicello erecto vel reflexo apice incrassato positus, bracteis multo longior. *Mericarpia* pallida laevia sed in sicco intense rugosa, facillime separata.

In dense hemispherical clumps or tufts up to 50 cm. across. *Stems* woody, much branched, the main branches very short. *Leaves* crowded, erect, terete, subpungent, glabrous or thinly hairy, 2—5 cm. long. *Umbels* hidden among the leaves. *Fruit* 3—4 mm. long, 4—6 mm. wide, flattened, pale-coloured, rather deeply emarginate at the top, slightly narrowed at the base and very shortly stipitate. *Mericarps* separating very easily, smooth when fresh but when dry with conspicuous curved ridges and deeply wrinkled furrows. *Fruit* much longer than the bracts, on an erect or reflexed ray about 1 cm. long and distinctly swollen in the upper part.

Among rocks on the upper parts of mountains in the extreme southwest. Very easily overlooked owing to the hidden flowers.

CAPE. Table Mt., *Garside* 6284 (type); *Adamson* 4389; *Esterhuysen* 16804, 16940, 16945. STELLENBOSCH. Jonkershoek Plateau, *Esterhuysen* 15241; Hottentots Holland, *Esterhuysen* 16725.

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WALGATE. 939 *montana.*
WALL. 2214/18 *coriacea;* 2452 *difformis.*
WEST, O. 1826 *coriacea.*
WILMAN, A. 1329 *coriacea;* 14198 *sessilis* ♂.
WILMS. 570 *coriacea;* 3249 *affinis.*
WOLLEY-DOD. 250 *affinis* v. *Richardiana;* 251 *eriantha;* 655 *macrocarpa;* 907 *tridentata;* 914 *affinis;* 964 *coriacea;* 1002 *eriantha;* 1118 *capensis;* 1477 *tridentata;* 1679 *tridentata;* 1982 *macrocarpa;* 2024 *coriacea;* 2081 *macrocarpa;* 2166 *hederaefolia;* 2309 *triloba;* 2330 *villosa;* 2895 *hederaefolia;* 3000 *tridentata;* 4019 *villosa.*
WOOD. 319 *glabrata* v. *natalensis;* 449 *glabrata* v. *natalensis;* 839, 839a *coriacea;* 3007 *glabrata* v. *natalensis;* 4301 *coriacea;* 10162 *glabrata* v. *natalensis.*
YOUNG, S. M. 15223 *sessilis* ♂.
ZEYHER. 1 *glabrata;* 4 *tridentata;* 7 *macrocarpa;* 18 *virgata;* 105 *debilis;* 129 *coriacea;* 727 *linifolia;* 742 *linifolia;* 776 *virgata;* 2158 *calliodus;* 2658 *affinis;* 2661 *lanata;* 2662 *flexuosa;* 2663 *calliodus;* 2664 *triloba;* 2666 *difformis;* 2667 *rupestris;* 2668 *virgata;* 4732 *capensis;* 4901 *macrocarpa.*

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THE GERMINATION OF THE SEEDS OF ANGIOSPERMOUS ROOT-PARASITES.

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Part III.

THE EFFECT OF TIME OF EXPOSURE TO THE HOST FACTOR ON THE GERMINATION OF THE SEED OF *ALECTRA VOGELII* BENTH.

Introduction.

As pointed out previously (Botha, 1948 and 1950, I) the germination process of the seed of *Alectra Vogelii* can be divided into two consecutive phases. During the first phase, which is brought about by moist conditions and a suitable temperature, the seed becomes sensitive to the host factor; and during the second phase, for which the presence of the host factor is essential, the radicle starts growing. It has also been pointed out elsewhere (Botha, 1950, II) that the time of pre-exposure to moist conditions, the temperature of pre-exposure and the concentration of the host factor are complementary in their effect on the percentage germination. These findings are consistent with the hypothesis put forward by Brown and Edwards (1946) with regard to the germination of the seed of *Striga lutea*, viz. that during "pretreatment" (pre-exposure to moist conditions) the seed itself produces a stimulating substance which is the same as or similar to that released by the host roots. In the present paper further evidence is presented in this connection.

Experimental Methods.

Four experiments were carried out. To distinguish between the four, I shall hereafter refer to them as Experiments 1, 2, 3 and 4.

In Experiments 1 and 2 aliquot lots of seed which had been pre-exposed for 10 days at 30°C. were exposed to different concentrations of the host factor for varying periods of time; and in Experiments 3 and 4 the effect of time of exposure to the host factor on the germination of aliquot lots of seed pre-exposed for different periods of time was investigated, undiluted host solution being applied. The effect of relatively long periods of exposure was examined in Experiments 1 and 3, while in Experiments 2 and 4 the time of exposure was varied over a much shorter range.

The several concentrations of the host stimulant applied in Experiments 1 and 2 were obtained by dilution of the host solution with appropriate volumes of distilled water. The concentration of the stimulant in the undiluted host solution was in each case taken to be 100 arbitrary units.

The method of exposing the seed to the host solution was as follows: Aliquot lots of the pre-exposed seed were transferred to small linen bags which were then suspended in the host solution. After the required time had elapsed, the bags were removed and thoroughly rinsed in running water. The seed was then brought into micro-culture at 30°C., drops of distilled water being used as culture medium. In all experiments aliquot lots of pre-exposed seed were also brought directly into micro-culture at 30° C., drops of the host solution being used as culture medium in this case. This latter treatment served as a control and is referred to as an exposure time of 3 days in the Tables. Exposure took place at room temperature (±18°C.) in Experiments 2 and 4 (short periods of exposure), while in Experiments 1 and 3 the solutions containing the seed were placed in the incubator at 30°C. during the time of exposure.

The details of the preparation of the host solutions and of the technique of the micro-culture method were essentially the same as those described elsewhere (Botha, 1950, I). Five replicates were involved in each germination test. Each percentage value in Tables 1, 4, 7 and 10 is, therefore, the mean of five observations. The results of all experiments were analyzed for variance.

RESULTS.

The results of Experiment 1 are presented in Tables 1—3, those of Experiment 2 in Tables 4—6, those of Experiment 3 in Tables 7—9 and those of Experiment 4 in Tables 10—12.

(1) *Experiments on the Effect of Time of Exposure in Relation to Concentration of the Host Factor.*

(*a*) *Experiment* 1.—From the data of this experiment it is clear that the time of exposure as well as the concentration of the host factor has a highly significant effect on the percentage germination and that the interaction between these two factors is also highly significant. (For each of these three components $P<0{\cdot}01$.)

TABLE 1.

THE EFFECT OF TIME OF EXPOSURE AND CONCENTRATION OF THE HOST FACTOR ON THE PERCENTAGE GERMINATION (EXPERIMENT 1).

Time of Exposure.	Concentration of the Host Factor (Arbitrary Units).			
	100	50	25	12·5
2 Hours	93·5	90·1	72·2	49·8
4 ,, ...	94·6	90·0	89·6	69·7
6 ,, ...	90·8	91·6	92·2	86·0
8 ,, ...	90·1	88·9	88·2	89·2
10 ,, ...	92·0	90·8	91·8	89·5
3 Days	92·5	90·5	94·1	91·6

Least Significant Difference (P=0·05): 3·5

TABLE 2.

THE EFFECT OF TIME OF EXPOSURE TO THE HOST SOLUTION ON THE PERCENTAGE GERMINATION (EXPERIMENT 1).

(Mean Values for all Concentrations.)

Time of Exposure.	2 Hours.	4 Hours.	6 Hours.	8 Hours.	10 Hours.	3 Days.	Least Sig. Diff. (P=0·05).
Mean Perc. Germ.	76·4	86·0	90·2	89·1	91·0	92·2	1·8

TABLE 3.

THE EFFECT OF CONCENTRATION OF THE HOST FACTOR ON THE PERCENTAGE GERMINATION (EXPERIMENT 1).

(Mean Values for all Times of Exposure.)

Concentration of the Host Factor (Arbitrary Units).	100	50	25	12·5	Least Sig. Diff. (P=0·05).
Mean Perc. Germ. ..	92·2	90·3	88·0	79·3	1·4

The results recorded in Table 2 show that the percentage germination increases as the time of exposure is lengthened from 2 hours to 6 hours, but with a further extension of this factor the germination remains constant, maximal values being obtained throughout. The data of Table 3 indicate that an increased dilution of the host factor is accompanied by a decrease in the percentage germination.

The information to be gained from Table 1 can be summarized as follows:

(i) With concentrations of 100 and 50 units an exposure time of 2 hours suffices to produce maximal germination. With 25 units maximal germination is attained after an exposure of 4 hours, and with 12·5 units this effect is produced after an exposure of about 6 hours.

(ii) With an exposure time of 2 hours dilution has the greatest effect, the means for 25 and 12·5 units being significantly lower than those for 100 and 50 units. With an extension of the time of exposure the effect of dilution decreases until it is scarcely noticeable with an exposure time of 6 hours. Maximal germination is obtained with all concentrations of the stimulant after exposure periods of 8 hours, 10 hours and 3 days.

(*b*) *Experiment* 2.—The data of Tables 4—6 also show that the time of exposure and the concentration of the host factor both have a pronounced effect on the percentage germination.

TABLE 4.

THE EFFECT OF TIME OF EXPOSURE AND CONCENTRATION OF THE HOST FACTOR ON THE PERCENTAGE GERMINATION (EXPERIMENT 2).

Time of Exposure.	Concentration of the Host Factor (Arbitrary Units).			
	100	50	25	12·5
15 minutes	53·1	45·1	22·8	10·9
30 ,, ...	72·3	57·0	34·4	20·6
45 ,, ...	82·2	67·4	43·0	30·5
3 days	92·3	91·1	90·0	87·9

Least Significant Difference (P=0·05): 4·2

TABLE 5.

THE EFFECT OF TIME OF EXPOSURE TO THE HOST FACTOR ON THE PERCENTAGE GERMINATION (EXPERIMENT 2).

(*Mean Values for all Concentrations.*)

Time of Exposure.	15 Mins.	30 Mins.	45 Mins.	3 Days.	Least Sig. Diff. (P=0·05).
Mean Perc. Germ. ..	33·0	46·1	55·8	90·3	2·1

TABLE 6.

THE EFFECT OF CONCENTRATION OF THE HOST FACTOR ON THE PERCENTAGE GERMINATION (EXPERIMENT 2).

(*Mean Values for all Times of Exposure.*)

Concentration of the Host Factor (Arbitrary Units).	100	50	25	12·5	Least Sig. Diff. (P=0·05).
Mean Perc. Germ. ...	75·0	65·2	47·6	37·5	2·1

From Table 4 it is evident that (i) with all concentrations of the stimulant all the means for time of exposure differ significantly from one another; and (ii) with exposure times up to 45 minutes all the means for concentration also differ significantly from one another, while in the case of the control (exposure time of 3 days) dilution has no appreciable effect, although the mean for 12·5 units is slightly lower than that for 100 units.

If the results of this experiment are compared with those of Experiment 1 it is clear that with short periods of exposure an extension of the time factor as well as a decrease in the concentration has a markedly more pronounced effect than with longer periods of exposure.

(2) *Experiments on the Effect of Time of Exposure in Relation to Time of Pre-exposure.*

(*a*) *Experiment* 3.—As regards the effect of time of exposure to the host stimulant the results of this experiment confirm the evidence obtained from Experiments 1 and 2, viz. that this factor has a highly significant effect on the percentage germination.

TABLE 7.

THE EFFECT OF TIME OF EXPOSURE TO THE HOST FACTOR ON THE PERCENTAGE GERMINATION OF SEED PRE-EXPOSED FOR DIFFERENT PERIODS (EXPERIMENT 3).

Time of Exposure.	Time of Pre-exposure.		
	3 Days.	6 Days.	9 Days.
1 Hour	49·7	76·0	87·4
2 Hours	68·3	79·1	91·8
4 ,, ...	73·6	87·1	91·6
8 ,, ...	89·1	90·4	91·0
3 Days	88·5	91·6	92·5

Least Significant Difference (P=0·05): 4·5

TABLE 8.

THE EFFECT OF TIME OF EXPOSURE TO THE HOST FACTOR ON THE PERCENTAGE GERMINATION (EXPERIMENT 3).

(Mean Values for all Times of Pre-exposure.)

Time of Exposure.	1 Hour.	2 Hours.	4 Hours.	8 Hours.	3 Days.	Least Sig. Diff. (P=0·05).
Mean Perc. Germ.	71·1	79·7	84·1	90·2	90·9	2·6

TABLE 9.

THE EFFECT OF TIME OF PRE-EXPOSURE ON THE PERCENTAGE GERMINATION (EXPERIMENT 3).

(Mean Values for all Times of Exposure.)

Time of Pre-exposure (Days).	3	6	9	Least Sig. Diff. (P=0·05).
Mean Perc. Germ.	73·8	84·9	90·9	2·0

The data of Tables 7 and 9 also show that the time of pre-exposure likewise affects the germination in a very pronounced way. With an extension of the period of pre-exposure the percentage germination increases (Table 9).

The most outstanding feature of the results of Experiment 3 is the fact that the interaction between the two factors involved is also highly significant. (For each of the three components, time of exposure, time of pre-exposure and interaction, $P<0\cdot01$.) The nature of this interaction is indicated by the data of Table 7, it being evident that (i) as the period of pre-exposure is extended maximal germination is attained with progressively shorter times of exposure; and (ii) with a lengthening of the time of exposure maximal germination is obtained with progressively shorter periods of pre-exposure.

(*b*) *Experiment* 4.—The information to be gained from the results of this experiment is essentially the same as that from Experiment 3. The time of exposure and the time of pre-exposure both affect the percentage germination in a highly significant way, and these two factors are complementary in action. Nearly all the differences between the means in Table 10 are significant.

The means obtained for pre-exposure periods of 3 and 6 days combined with an exposure time of 3 days (Table 10) are lower than the corre-

TABLE 10.

THE EFFECT OF TIME OF EXPOSURE TO THE HOST FACTOR ON THE PERCENTAGE GERMINATION OF SEED PRE-EXPOSED FOR DIFFERENT PERIODS (EXPERIMENT 4).

Time of Exposure.	Time of Pre-exposure.		
	3 Days.	6 Days.	9 Days.
15 Minutes	5·0	11·3	27·8
30 „	9·8	14·5	34·0
45 „	12·1	24·8	41·3
90 „	29·7	41·8	72·5
3 Days	44·0	60·1	89·7

Least Significant Difference (P=0·05): 3·7

TABLE 11.

THE EFFECT OF TIME OF EXPOSURE TO THE HOST FACTOR ON THE PERCENTAGE GERMINATION (EXPERIMENT 4).

(Mean Values for all Times of Pre-exposure.)

Time of Exposure.	15 Mins.	30 Min.	45 Mins.	90 Mins.	3 Days.	Least Sig. Diff. (P=0·05).
Mean Perc. Germ.	14·7	19·4	26·1	48·0	64·6	2·1

TABLE 12.

THE EFFECT OF TIME OF PRE-EXPOSURE ON THE PERCENTAGE GERMINATION (EXPERIMENT 4).

(Mean Values for all Times of Exposure.)

Time of Pre-exposure (Days).	3	6	9	Least Sig. Diff. (P=0·05).
Mean Perc. Germ.	21·2	30·5	53·1	1·6

sponding means in Table 7. Obviously the concentration of the host factor applied in Experiment 4 was lower than that used in Experiment 3. With this lower concentration of the stimulant the only mean that is more or less maximal is that for a pre-exposure period of 9 days combined with an exposure time of 3 days (Table 10).

DISCUSSION.

The results of this investigation indicate that when the seed is properly "sensitized", and a high concentration of the host factor is applied, a relatively short time of exposure to the latter suffices to produce a high percentage germination. To germinate, the seed need not be in contact with the host solution during the entire second phase of germination. In Experiment 1 an exposure time of 2 hours to the undiluted host solution was sufficient to produce maximal germination in the "sensitized" seed (Table 1); in Experiment 3 more or less the same effect was obtained with a pre-exposure period of 9 days combined with an exposure time of 1 hour (Table 7); and in Experiment 2 more than 50 per cent of the "sensitized" seed germinated after an exposure of 15 minutes to the undiluted host solution (Table 4).

This evidence is in accordance with the results of Chabrolin (1939) and Brown and Edwards (1946) who investigated the germination of the seeds of *Orobanche speciosa* and *Striga lutea*, respectively. The former found that the action of the host factor on the "sensitized" seed is practically instantaneous. After only 30 seconds of immersion of this seed in an active decoction, followed by washing in running water for 10 minutes, the germination exceeded 60 per cent. He suggested that two substances which have a great affinity for one another are involved in the germination process. The one occurs in the "sensitized" seed and the other in the host solution. The latter penetrates very quickly into the living cells from which it cannot be removed by washing. Within the seed a chemical reaction takes place between these two substances (p. 126). To my mind, the idea that the pre-exposed seed contains a substance which is the same as or similar to that released from the host roots and that these two substances are complementary in action seems to be more feasible.

The results of Brown and Edwards (1946) indicate that a high percentage germination can also be obtained in pre-exposed seed of *Striga lutea* after relatively short periods of exposure to the host stimulant. With regard to the effect of time of exposure they distinguished between two phases, viz. an initial phase of superficial absorption of the host stimulant by the seed, followed by assimilation into the seedling. They found that with exposure to the host solution for 2, 4, 6 and 24 hours the effect of dilution of the host factor is, relatively, always the same, and that only in certain cases is there an increase in the germination as the period of exposure is increased. These observations were taken by them to indicate that absorption by the seed of the stimulant from the solution is complete within 2 hours. From my experiments no evidence could be obtained that in the case of *A. Vogelii* absorption is always complete within such a short period. Indeed, the results of Experiment 1 (Table 1) indicate that at 30° C. and with low concentrations of the host stimulant absorption may continue up to 6 hours or even longer.

It is, however, difficult to base any conclusions on this comparison of data, especially since it is not certain at what temperature exposure was carried out in the experiments of Brown and Edwards.

The interaction between time of exposure and concentration of the host factor, as observed in Experiments 1 and 2 of the present investigation, is quite comprehensible. Essentially the effect of only one factor was involved in these experiments, viz. that of the amount of the host stimulant absorbed by the seed. With an increase in the time of exposure the amount absorbed increases; and with an increase in the concentration of the stimulant in the host solution absorption is accelerated. This explains why (i) with an extension of the time of exposure progressively lower concentrations of the stimulant need be applied to produce maximal germination; and (ii) with an increase in the concentration of the stimulant the same effect can be obtained with progressively shorter times of exposure (Table 1).

As regards the interpretation of the results of Experiments 3 and 4 there is more uncertainty. Clearly the two factors involved, namely time of pre-exposure to moist conditions and time of exposure to the host solution, are also complementary in action. The most plausible explanation of this seems to be the hypothesis put forward by Brown and Edwards (1946) and already referred to above, viz. that during pre-exposure the seed itself synthesizes a substance which is the same as or similar to the stimulating substance released from the host roots. This hypothesis implies that during pre-exposure the amount of the substance formed in the seed itself gradually increases. And since the evidence of the present investigation indicates that the amount of the host stimulant absorbed by the seed increases with a lengthening of the time of exposure up to a certain point, it becomes clear that: (i) With an extension of the period of pre-exposure maximal germination can be obtained with propressively shorter times of exposure; and (ii) with a lengthening of the time of exposure the same effect can be produced with progressively shorter periods of pre-exposure.

SUMMARY.

1. Four two-factor experiments were carried out to study the effect of time of exposure to the host factor on the germination of the seed of *Alectra Vogelii.* In Experiments 1 and 2 the influence of this factor was investigated in relation to different concentrations of the stimulant; and in Experiments 3 and 4 its effect was studied in relation to various periods of pre-exposure of the seed to moist conditions.

2. In Experiments 1 and 2 it was found that the percentage germination increases with an increase in the time of exposure as well as with

an increase in the concentration of the host factor. The interaction between these two factors is highly significant. With long periods of exposure lower concentrations of the host factor are required to produce a high percentage germination than with short periods; and with high concentrations of the stimulant shorter periods of exposure are necessary to obtain the same effect than with low concentrations.

3. The results of Experiments 3 and 4 indicate that the factors, time of pre-exposure to moist conditions and time of exposure to the stimulant, are also complementary in action. With long periods of pre-exposure relatively short times of exposure are required to produce maximal germination; and with long times of exposure maximal germination can also be obtained after relatively short periods of pre-exposure.

4. These findings are consistent with the hypothesis that during pre-exposure the seed itself produces an active substance which is the same as or similar to that released from the host roots.

Part IV.

THE PROPERTIES AND PHYSIOLOGICAL SIGNIFICANCE OF THE HOST FACTOR NECESSARY FOR THE GERMINATION OF THE SEED OF *ALECTRA VOGELII* BENTH.

Introduction.

In a previous paper (Botha, 1948) preliminary results were presented which indicate that the host factor necessary for the germination of the seed of *Alectra Vogelii* is an unstable substance. When fresh host solutions were exposed to 60°C. and above they became less active within a relatively short time. At boiling point such solutions were totally inactivated within 10 minutes. When aged at room temperature in unstoppered flasks they retained their activity for longer periods, total inactivation occurring after from 4 to 8 days.

During the present investigation the instability of this substance was studied in more detail, particularly for the purpose of gaining more knowledge about its physical properties, chemical nature and physiological significance. Two aspects of this problem were investigated, viz. (*a*) the effect of temperature on the stability of the substance; and (*b*) the cause(s) of the instability of the substance at temperatures which correspond more or less to those prevailing under natural summer conditions. With regard to (*b*) several possibilities, which have already been enumerated previously (Botha, 1948), may be considered, the most important being:

(1) The substance may be of a volatile nature and may consequently escape from solution even at relatively low temperatures.
(2) The substance may be liable to oxidation by atmospheric oxygen.
(3) The substance may be sensitive to light.
(4) The substance may be decomposed by micro-organisms.
(5) Like certain other active substances, the substance may undergo other chemical changes, such as changes through isomerization and denaturation.

Most of these possibilities were investigated experimentally. With regard to those mentioned under (1), (2) and (3), the results were entirely negative, thereby indicating that the substance is obviously not of a volatile nature and that atmospheric oxygen and light have no appreciable effect on its stability. For the sake of brevity I shall not discuss the experiments carried out in this connection, but shall confine myself more particularly to the effect of micro-organisms on the stability of the host factor.

A further aspect of the present investigation was concerned with the possibility of the host factor being identical with, or similar in action to some active substance or other which is known to occur in plants. Since the host stimulant is definitely soluble in water, substances insoluble in water, e.g. the fat soluble vitamins, could be excluded. The possibility of its being identical with any of the following substances was investigated: aneurine (thiamin), riboflavin, nicotinic acid amide, ascorbic acid (vitamin C), pyridoxine and heteroauxin.

EXPERIMENTAL METHODS.

The host solutions were obtained from young cowpea plants cultured in distilled water. The details of obtaining these solutions and of the procedure of the germination tests were essentially the same as those given in the first paper of this series (Botha, 1950, I). In all experiments the *Alectra* seed was pre-exposed to moisture for 10 days at 30°C. before being used in the germination tests. All germination tests were replicated six times and the results were analysed for variance where necessary.

Experiment 1.—The effect of high temperatures (40—97°C.) on the stability of the host factor was investigated in this experiment. A fresh host solution was divided into several aliquot portions. Each portion was quickly heated to the desired temperature, kept at this temperature for the desired period of time and then quickly cooled in ice-cold water. To prevent evaporation, the flasks in which the solutions were heated, were furnished with reflux condensers. After the solutions had been cooled, their activity was tested on the pre-exposed seed.

Experiment 2.—In this experiment the effect of lower temperatures was studied. A fresh host solution was divided into four aliquot portions and stored in dark stoppered flasks at four different temperatures (30°C., 20°C., 10°C. and 0·5°C.). At certain intervals germination tests were carried out with small quantities of each solution.

Experiments 3 *and* 4.—In these two experiments the effect of micro-organisms on the stability of the host factor at room temperature and at 30°C. was investigated. Before these experiments could, however, be undertaken, several preliminary experiments had to be carried out in order to devise a convenient method for sterilizing or disinfecting the host solutions. Since the host factor is thermolabile, it was thought that sterilization by heat would probably not suit the purpose and recourse was therefore taken to chemical methods of disinfection. The suitability of various disinfectants, such as chloroform, ether, "Dettol," and silver nitrate, was tested. Of these, the last was found to be the most convenient. Silver nitrate has the advantage that the poisonous principle, silver, can easily be removed from the test solution before the germination tests are carried out. The effect of various concentrations of this disinfectant was also studied in preliminary experiments and it was found that a 1 per cent solution suited the purpose satisfactorily.

Each of the two main experiments (Experiments 3 and 4) was carried out as follows: A fresh host solution was divided into two aliquot portions. An appropriate amount of silver nitrate to obtain a 1 per cent solution of this disinfectant was added to the one portion (the test solution). No disinfectant was added to the other portion (the control solution).

The solutions were stored in dark stoppered flasks and at certain intervals small quantities of both were removed to carry out germination tests. In Experiment 3 the solutions were stored at room temperature, whereas in Experiment 4 they were stored in the incubator at 30°C.

Immediately before the germination tests were carried out, the removed solution samples were prepared as follows:

(*a*) *Test Solution.*—To 12·0 ml. of the test solution was added 3·5 ml. of a potassium chloride solution. The added amount of the latter solution contained slightly more than the amount of chloride necessary to precipitate all the silver in the 12·0 ml. of the test solution. The resulting silver chloride precipitate was filtered off, dry apparatus being used for filtering. The activity of the filtrate was then tested on pre-exposed *Alectra* seed.

(*b*) *Control Solution.*—From the procedure described under (*a*) it is clear that the addition of the potassium chloride solution to the test solution brought about a decrease in the concentration of the host factor; and that the filtrate contained potassium nitrate, since potassium chloride reacts with silver nitrate to form potassium nitrate. Both of these factors may affect the germination and this possibility was taken into consideration in preparing the control solution. To a first quantity of 12·0 ml. of the latter solution 3·5 ml. of a potassium nitrate solution was added. The amount of potassium nitrate added was equal to the amount of this substance formed in the test solution. The solution obtained in this manner is referred to as Control Solution 1.

A second quantity of 12·0 ml. of the control solution was diluted with 3·5 ml. of distilled water. The solution thus obtained, is called Control Solution 2.

From the above it is clear that the prepared test solution (filtrate of treatment under (*a*)) and Control Solution 1 contained the same concentration of potassium nitrate and that both solutions were diluted to the same extent. Control Solution 2 was also diluted to this extent but contained no potassium nitrate. From a comparison of the results obtained with Control Solutions 1 and 2 in the germination tests, it should therefore be possible to determine whether the presence of the

KNO_3 had an effect on the germination; and by comparing the data obtained with the test solution with those obtained with the two control solutions, it should be possible to determine the effect of disinfection on the stability of the host factor, provided that the effect of the KNO_3 was not decisive and that the host factor was not adsorbed by the silver chloride precipitate.

Experiments 5 *and* 6.—The effect on the germination of the *Alectra* seed of the active substances already mentioned was studied in these experiments. The sources of the substances applied were the following: for vitamin C—pure ascorbic acid; for "Vitamin B Complex"—"Benerva" tablets (Roche) each of which contained 1 mg. aneurine, 1 mg. riboflavin and 15 mg. nicotinic acid amide; for pyridoxine hydrochloride—"Hexabetalin" tablets (Lilly); and for heteroauxin—pure indole-3-acetic acid.

In order to obtain solutions of these substances, they were dissolved in aliquot portions of host solution and in distilled water. In the case of "Vitamin B Complex" and pyridoxine the tablets were first levigated, the appropriate amount of host solution or distilled water being added and then the insoluble ingredients were removed by filtration.

In Experiment 5 separate solutions of "Vitamin B Complex," vitamin C and heteroauxin were applied and in Experiment 6 each test solution contained a mixture of all the active substances mentioned above. The concentrations applied are given in Tables 5 and 6. These concentrations, as well as that of the host factor, were relatively high in Experiment 5, whereas in Experiment 6 low concentrations were applied. Since a fairly high percentage germination was obtained with a crude concentrate of the host factor at a dilution of 1 : 1,000,000 (Botha, unpublished work), these low concentrations were considered adequate for the purpose of the present investigation.

RESULTS.

1. *The Effect of High Temperatures on the Stability of the Host Factor* (*Experiment* 1).

The results of Experiment 1, which are recorded in Table 1, definitely indicate that the host factor is thermolabile. There was no appreciable decrease in the percentage germination induced by the host solutions which were pre-heated at 40°C., 50°C. and 60°C. for periods of up to 45 minutes. This also applied to pre-heating at 70°C. for periods of 15 and 30 minutes, but a slight decrease in activity was evident in the solution which was exposed for 45 minutes at this temperature. After exposure to 80°C., 90°C. and 97°C. (boiling point) there was a very pronounced decrease in the activity of the host factor. At boiling point it was practically completely inactivated within 15 minutes.

TABLE 1.

THE EFFECT OF HIGH TEMPERATURES ON THE ACTIVITY OF THE HOST FACTOR AS REFLECTED BY THE PERCENTAGE GERMINATION.

Temperature to which Heated (°C.).	Duration of Heating.		
	15 minutes.	30 minutes.	45 minutes.
40	86·6±1·9	89·1±2·0	88·4±0·6
50	85·5±1·3	90·0±1·8	87·5±1·5
60	83·5±1·7	87·6±1·6	85·3±2·2
70	89·1±1·8	91·6±1·8	77·5±1·8
80	61·8±3·7	5·8±1·3	1·3±0·7
90	28·4±2·2	0·7±0·7	3·1±1·3
97 (boiling point)	1·5±0·9	0·0	0·0

Control (solution not heated): 86·7±0·5

2. *The Effect of Temperatures of 30°C. and below on the Stability of the Host Factor* (*Experiment* 2).

The results of the second experiment are given in Table 2. These data show that the stability of the host factor increases with a fall in temperature. The first decrease in its activity was evident after storage for 4 days at 30°C., after 6 days at 20°C. and after 8 days at 10°C., and inactivation was practically complete after 12 days at 30°C. and 20°C. and after from 18 to 27 days at 10°C. Germination could not be induced with solutions stored at 30°C., 20°C. and 10°C. when they were 27 days

TABLE 2.

THE EFFECT OF AGEING AT DIFFERENT TEMPERATURES ON THE ACTIVITY OF THE HOST SOLUTION AS REFLECTED BY THE PERCENTAGE GERMINATION.

Age of Solution in Days.	Temperature at which Solution was Stored.			
	0·5°C.	10°C.	20°C.	30°C.
2	98·2±2·4	92·3±1·4	96·1±1·5	96·5±0·9
4	94·2±1·1	96·3±1·5	93·4±1·4	69·7±4·8
6	97·1±0·7	92·9±2·5	56·0±4·5	27·7±3·5
8	96·7±1·0	80·8±6·2	31·6±6·1	15·5±3·5
10	96·6±0·5	52·9±3·6	16·7±3·7	18·7±8·3
12	95·3±1·1	23·5±6·6	2·4±1·0	0·7±0·4
14	94·5±1·1	16·4±4·6	1·4±0·6	1·8±1·0
18	97·2±1·4	8·6±4·9	0·6±0·6	1·0±0·6
27	95·6±1·7	0·0	0·0	0·0
41	95·3±2·4	—	—	—
99	89·0±1·8	—	—	—

Controls: 1. Fresh Solution: 96·5±1·0
2. Distilled Water: 1·3±0·7

old and the experiment was therefore terminated at this stage as far as these temperatures were concerned. Since the solution stored at 0·5°C. was, however, still fully active at this time, it was left in the refrigerator for further observations. When this solution was 41 days old, its activity still showed no decline and after storage for 99 days it still induced germination in about 90% of the seeds.

From these observations it is clear that the host stimulant retains its activity for months when stored at a temperature slightly above freezing point. This fact was very helpful in simplyfying the germination technique for *A. Vogelii*, since in many types of experiment it obviates the necessity of preparing a fresh host solution for each germination test, when a series of consecutive tests have to be carried out over relatively long periods.

3. *The Effect of Micro-Organisms on the Stability of the Host Factor (Experiments* 3 *and* 4).

The results of Experiment 3 are presented in Table 3. From a comparison of the data in the third and fourth columns of this table it is clear that in general the values obtained with Control Solution 1 agree rather closely with the corresponding values obtained with Control Solution 2. This indicates that the presence of potassium nitrate in the former solution did not appreciably affect the percentage germination. In both control solutions the first decrease in activity became evident after storage for 12 days. When these solutions were 21 days old, they were completely inactive. The disinfected test solution, however, retained its original activity for at least 15 days. After storage for 21 days there evidently was a slight decrease in the activity of this solution, but no further decline in activity occurred from this time until the experiment was terminated. When it was 57 days old, this solution could still induce germination in approximately 85% of the seeds. It is evident from these observations that the host factor is fairly stable in a properly disinfected solution when stored at room temperature.

The results of Experiment 4, which are given in Table 4, also show that the potassium nitrate had no appreciable effect on the germination, there being no significant differences between the corresponding values for Control Solutions 1 and 2. In this experiment a very marked decrease in the activity of the control solutions was already noticeable after storage for 8 days. When they were 17 days old, these solutions were nearly completely inactive. The disinfected test solution, on the other hand, retained its original activity for at least 8 days. After storage for 17 days, a decline in activity was, however, also evident in this solution,

TABLE 3.

THE EFFECT OF DISINFECTION WITH SILVER NITRATE ON THE STABILITY OF THE HOST FACTOR AS REFLECTED BY THE MEAN PERCENTAGE GERMINATION. (Solutions stored at room temperature—mean minimum: 17·7°C.; mean maximum: 23·6°C.)

Age of Solution in Days.	Test Solution(1) (Disinfected).	Control Solution 1.(2)	Control Solution 2.(3)
0 (fresh)	93·1	91·3	91·1
3	94·5	95·5	93·0
6	93·1	90·9	90·7
9	89·5	88·0	95·7
12	93·7	64·4	70·2
15	93·9	11·7	14·0
21	81·4	0·0	0·0
27	86·7	0·0	0·0
33	82·9	0·0	0·0
45	83·3	0·0	0·0
57	86·5	0·0	0·0

Least Significant Difference (P=0·05): 3·5

(1)*Test Solution:* Filtrate of 12·0 ml. disinfected solution+3·5 ml. KCl solution.
(2)Control Solution 1: 12·0 ml. control solution+3·5 ml. KNO_3 solution.
(3)Control Solution 2: 12·0 ml. control solution+3·5 ml. distilled water.

TABLE 4.

THE EFFECT OF DISINFECTION WITH SILVER NITRATE ON THE STABILITY OF THE HOST FACTOR AS REFLECTED BY THE MEAN PERCENTAGE GERMINATION. (Solutions stored at 30°C.)

Age of Solution in Days.	Test Solution* (Disinfected).	Control Solution 1.*	Control Solution 2.*
0 (fresh)	97·4	95·7	97·6
4	92·6	90·4	90·2
8	92·4	42·3	43·2
17	80·7	1·8	4·3
31	14·3	0·0	0·3

Least Significant Difference (P=0·05): 6·7

*Solutions treated as in Table 3.

and at the age of 31 days inactivation had progressed to a very advanced stage. It is therefore clear that disinfection with silver nitrate is not an efficient method for preserving the host factor in solution at 30°C., although it also has a pronounced retarding effect on the inactivation process at this temperature.

4. *The Effect of Various Active Substances on the Germination of* Alectra *Seed.*

From the results of Experiment 5, which are given in Table 5, it is

TABLE 5.

THE EFFECT OF "VITAMIN B COMPLEX," VITAMIN C AND HETEROAUXIN ON THE GERMINATION OF THE SEED OF *A. Vogelii* (EXPERIMENT 5).

Treatment.	Percentage Germination.
1. "Vitamin B Complex" in Host Solution*	30·4 ± 18·6
2. "Vitamin B Complex" in Distilled Water*	0·0
3. 50 mg. Ascorbic Acid/100 ml. Host Solution	87·7 ± 1·4
4. 50 mg. Ascorbic Acid/100 ml. Distilled Water	0·0
5. 1 mg. Heteroauxin/100 ml. Host Solution	94·0 ± 1·5
6. 1 mg. Heteroauxin/100 ml. Distilled Water	0·0
7. Host Solution	87·1 ± 3·7
8. Distilled Water	0·0

*4 mg. aneurine, 4 mg. riboflavin and 60 mg. nicotinic acid amide per 100 ml. solvent.

clear that none of the active substances in question could induce germination in the seed of the parasite. The presence of ascorbic acid and heteroauxin in the host solution did not appreciably affect the germination brought about by the natural stimulant. The presence of "Vitamin B Complex" did, however, seem to have a detrimental effect on the germination. This may be due to an inhibitory action either of the active substances themselves, or of other soluble ingredients of the tablets used.

The results presented in Table 6 indicate that the combination of

TABLE 6.

THE EFFECT OF MIXTURES* OF "VITAMIN B COMPLEX," VITAMIN C, PYRIDOXINE HYDROCHLORIDE AND HETEROAUXIN ON THE GERMINATION OF THE SEED OF *Alectra Vogelii* (EXPERIMENT 6).

Treatment.	Percentage Germination.
1. Mixture 1 dissolved in Host Solution	30·1 ± 2·8
2. Mixture 1 dissolved in Distilled Water	0·0
3. Mixture 2 dissolved in Host Solution	43·4 ± 6·1
4. Mixture 2 dissolved in Distilled Water	0·0
5. Mixture 3 dissolved in Host Solution	35·4 ± 5·9
6. Mixture 3 dissolved in Distilled Water	0·0
7. Mixture 4 dissolved in Host Solution	43·6 ± 3·8
8. Mixture 4 dissolved in Distilled Water	0·0
9. Host Solution	51·8 ± 5·8
10. Distilled Water	0·0

**Ingredients of Mixtures.*

(*a*) *Mixture* 1: 1 mg. aneurine, 1 mg. riboflavin, 15 mg. nicotinic acid amide, 2 mg. ascorbic acid, 2 mg. pyridoxine hydrochloride and 2 mg. heteroauxin per litre solvent.

(*b*) *Mixtures* 2, 3 *and* 4: The same ingredients, but concentrations respectively 25%, 10% and 1% of that in Mixture 1.

active substances applied in Experiment 6 did likewise not cause germination of the seeds. When applied in the presence of the host factor, this combination had an inhibitory effect.

DISCUSSION.

With the present investigation definite evidence has been obtained that the host factor of *A. Vogelii* is an unstable substance. At a temperature slightly above freezing point solutions of this substance can be stored for long periods without losing their activity, but with a rise in temperature, the rate of inactivation increases. At temperatures of 70°C. and above a decrease in activity occurs within a relatively short time.

At room temperature the instability of the substance in unsterilized solutions is due almost exclusively to decomposition by micro-organisms. The effect of micro-organisms is also clearly noticeable at 30°C., but at this temperature other chemical changes, which are as yet unknown, evidently occur as well.

The negative results obtained in Experiments 5 and 6 indicate that the host factor is obviously not identical with any of the following active substances: thiamin, riboflavin, nicotinic acid amide, ascorbic acid (vitamin C), pyridoxine and heteroauxin. In this connection it must, however, be borne in mind that the host stimulant may not be a single substance, but may be a complex of various factors acting in unison and constituting what is called by Schopfer (1943) a *constellation*. If this is so, it is clear that the mixture of substances applied in Experiment 6 (Table 6) evidently did not contain all the constituents of this constellation. The mixture might have contained some of the constituents, but it might just as well be that the host stimulant is composed of an entirely different set of factors.

Bearing in mind the abovementioned and other properties of the host stimulant, I shall now endeavour to elucidate its relation to other active substances occurring in plants.

The active substances ("Wirkstoffe" or *ergines*, according to Ammon and Dirscherl, 1948) are usually divided into three groups, viz. enzymes, hormones and vitamins. The question now arises whether the host stimulant of *A. Vogelii* belongs to any of these three categories. In endeavouring to decide this question, it will be necessary to give in outline the criteria for distinguishing between the three.

The enzymes can be distinguished from the other two groups on account of the fact that they are either proteins or proteids and are consequently colloidal substances with relatively large molecules. Like other proteinaceous substances, they are usually thermolabile and undergo denaturation when stored in solution. Being colloids, they are usually not dialisable. Although there are many interrelations between enzymes, hormones and vitamins and although, according to the "Träger" theory, vitamins and hormones may actually form part of the constitution of active enzymes, the trained physiologist can usually decide with a fair amount of certainty whether a substance is an enzyme, or not.

From the botanical point of view it is, however, often extremely difficult to distinguish between hormones and vitamins. Several authors have already stressed this difficulty. Schlenker (1937, p. 79) states: "Es ist neuerdings bezweifelt worden, ob die Unterscheidung zwischen Hormonen und Vitaminen in der tierischen Physiologie noch Berechtigung hat, in der pflanzlichen Physiologie ist sie sicher nicht sinnvoll." Von Euler (1938) also realized this difficulty and proposed the term *ergone* to be used for hormones and vitamins in all cases in which it is not easy to distinguish between these two. More recently Schopfer (1943 and 1949) based a distinction between the two on their mode of action. He considers an action as hormonal if the substance in question acts, in the final analysis, specifically on the morphology of the organism. An action of vitamin nature is, on the other hand, according to him concerned with the intermediate metabolism and does not, in the final analysis, affect the morphology of the organism in a specific manner. He does, however, admit that even in his system, some substances are difficult to classify.

On account of this uncertainty with regard to the terminology, it is difficult to decide what place the host stimulant of *A. Vogelii* is to take among the active substances. This substance has the following two properties in common with enzymes: (*a*) it is thermolabile; and (*b*) apart from the fact that it can be decomposed by micro-organisms, it obviously also undergoes slow chemical changes when stored in solution at warm temperatures. It must, however, be stressed that these properties by no means guarantee that the substance is an enzyme. With regard to (*a*) it must be pointed out that, although inactivation by heat is in most cases so characteristic of enzymes that it is still at present used as a criterion for distinction, many authorities, e.g. Ammon and Dirscherl (1948), rightly consider this test as unreliable. And with regard to (*b*) it must be borne in mind that some active substances which clearly do not belong to the enzymes, also undergo chemical changes when stored. Kögl, Koningsberger and Erxleben (1936) have, for instance, found that pure auxin becomes physiologically inactive within a few months, even when sealed *in vacuo* and stored in the dark.

Much importance can, therefore, not be attached to these similarities between the host stimulant and enzymes. Indeed, some of my unpublished results are not consistent with the possibility of the substance being an enzyme. It has, for instance, been found that the substance can pass through collodion and animal membranes and is therefore obviously a crystalloid (Botha, unpublished). The fact that the substance is absorbed by the seed material of *A. Vogelii* in physiologically active quantities within a relatively short time (Botha, 1951, III, above) may also be taken to indicate that it is probably not a colloid.

The second possibility, viz. that the stimulant may be a hormone, will now be considered. Since two of the well known phytohormones, viz. auxin A and auxin B, are thermostable, it is clear that the stimulant is not identical with these two substances. The possibility of its being identical with the so-called "rhizocaline" of Bouillenne and Went (1933) must be excluded for the same reason. As already mentioned, the results of the present investigation show that it also is probably not identical with heteroauxin. From these considerations it may be concluded that, if the substance is a phytohormone, it evidently belongs to a group of hormones which is as yet unknown.

In this connection the recent work of Brown and his collaborators (Brown, Johnson, Robinson and Todd, 1949; and Brown, Robinson and Johnson, 1949) is particularly interesting. According to them the stimulant necessary for the germination of the seed of *Striga hermonthica* only acts at a comparatively late stage in the germination process, and then it has the effect of promoting the extension of the cells of the radicle. They have found that this stimulant also promotes cell extension in segments of pea-roots. This effect might clearly be considered as hormonal. Although they did not succeed in isolating the stimulant in the pure state, they have found that concentrates of the host root exudations contain pentose sugars which are probably not aldopentoses, and that a simple sugar, viz. D-xyloketose, also induces germination in the seed of the parasite. The effect of this sugar on segments of pea-roots is, according to their results, similar to that of the natural stimulant. They conclude that the activity of their concentrates was due to a substance which is either very similar to or identical with D-xyloketose. Furthermore, they rightly point out that theirs is the first record of a stimulating effect on the growth of plant tissues of a simple sugar in concentrations of less than 10 mg./litre.

The third possibility, viz. that the host stimulant of *A. Vogelii* may be a vitamin, also seems to be quite feasible. The mere fact that the parasite requires an active substance from an external source for the germination of its seed, suggests that it has lost the capability of synthesizing some substance or other which is essential for germination. Such a loss of the capacity to synthesize essential active substances is by no means uncommon in plants. Schopfer (1943) cites many examples of lower plants in which it occurs and also points out that it is met with in higher plants as well. In discussing the work of Burgeff (1936) and others on the germination of the seeds of orchids with endotrophic mycorrhiza, he (l.c., p. 251) states: "Thus the problem is placed in its true perspective when we say that, as in the case of auxo-heterotrophic micro-organisms, the orchid embryo suffers an avitaminosis which can be compensated by supplying the medium with the missing factor which the plant is no longer able to synthesize."

When the results of Burgeff (1936) on the germination of the seeds of certain orchid genera are compared with the available data on the germination of the seeds of angiospermous root-parasites, a striking similarity in essential points is evident. Like the orchid seed, the seed of the parasite probably suffers an "avitaminosis." To my mind the loss of the capacity to synthesize the substance necessary for germination is, however, not complete in the case of the parasite. During pre-exposure to moist conditions an inadequate amount of this substance is formed in the seed and this amount has to be supplemented with the host factor before germination can take place. The definition of a vitamin in its more or less classical sense is indeed applicable to the host stimulant in so far as it is synthesized in one organism (the host) and has a catalytic action in another (the parasite). Since there is, however, reason to believe that this substance induces cell extension in the radicle of the parasite, it may, on the other hand, be considered as hormonal in its mode of action.

In view of all these considerations I am of the opinion that, until further information on its properties and mode of action is available, it will be safest to classify the host stimulant of *A. Vogelii* under von Euler's (1938) ergones (see above). To my mind the host factors of various other angiospermous root-parasites which have been studied hitherto, also belong to this group of active substances, e.g. that of *Striga lutea* (studied by Saunders, 1933; and Brown and Edwards, 1944 and 1946), that of *Striga hermonthica* (studied by Andrews, 1945; Brown and his co-workers (see above); and Vallance, 1950 and 1951) and that of *Orobanche speciosa* (studied by Chabrolin, 1939).

In order to distinguish the host stimulants of the angiospermous root-parasites from other ergones, it is, to my mind, in any case necessary to introduce a special term. I propose the term *parasitoblastin** for this purpose. A parasitoblastin may be defined as an organic substance or a group of organic substances which is released by the roots of non-parasitic flowering plants and which, when present in minute quantities, induces germination in the seed of some angiospermous root-parasite or other. To avoid misunderstanding, I particularly wish to stress the possibility that a parasitoblastin might not be a single substance but might be composed of two or more factors acting in unison and supplementing certain germination ergones which the parasite is no longer able to synthesize in sufficient quantities.

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*On account of its possible role in germination Cholodny (1935) proposed the term *blastanin* for the hormone produced in the endosperm of the *Avena* seed. Went and Thimann (1937, p. 63) pointed out that, since the activity of this substance was determined on *Avena*, it falls under the definition of auxin. Cholodny's term is, therefore, obviously redundant.

The host-dependent germination of the seeds of angiospermous root-parasites must obviously be explained as follows: In their adaptation to the parasitic mode of life these plants have, to a great extent, lost the capacity to synthesize certain ergones which are essential for the germination of their seeds. These or similar ergones, viz. the parasitoblastins, they now obtain from the host roots. This idea may serve as a working hypothesis for further research in this direction.

SUMMARY.

1. Several experiments were carried out to study the effect of temperature and of disinfection on the stability of the host factor necessary for the germination of the seed of *A. Vogelii.*

2. It was found that the stimulant is thermolabile, inactivation occurring within a relatively short time at temperatures of 70°C. and above. At a temperature slightly above freezing point solutions of the substance can be stored for long periods without losing their activity, but as the temperature rises, the rate of inactivation increases.

3. At room temperature (18—24°C.) the instability of the substance in unsterilized solutions is almost exclusively due to decomposition by micro-organisms. The effect of micro-organisms is also clearly noticeable at 30°C., but at this temperature other, unknown chemical changes evidently occur as well.

4. Experiments were also carried out to determine whether the host factor is identical with some active substance or other which is known to occur in plants. The results obtained, indicate that the stimulant is probably not identical with any of the following substances: Auxin A, auxin B, heteroauxin, rhizocaline, thiamin, riboflavin, nicotinic acid amide, pyridoxine and vitamin C.

5. The possible relation of the stimulant to other active substances is discussed and it is concluded that it must evidently be classified with von Euler's *ergones.*

6. The term *parasitoblastins* is suggested for the host factors necessary for the germination of the seeds of angiospermous root-parasites.

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NOTES ON STERCULIA ALEXANDRI, Harv.

(With Plates I and II.)

By Eily E. A. Archibald.

The genus *Sterculia* is represented in South Africa by three species, two of these, *S. murex* and *S. rogersii*, being confined to the Northern Transvaal and Swaziland and the third, *S. alexandri*, occurring in only two localities in the Eastern Cape Province. The following notes deal with the variations in the growth of *S. alexandri* in these two localities.

The type specimens were collected by Dr. Alexander Prior in 1848 in the Winterhoek Mountains north of Uitenhage. These mountains are one of the most easterly extremities of the coastal fold belt; they are formed mainly of Table Mountain Sandstone and are deeply dissected by narrow valleys. In these valleys, within a rather restricted area, occasional groups of *S. alexandrii* occur, both on the margin of macchia-like bush near dry river beds and in the open on the hill slopes. The vegetation on the slopes is unstable owing to burning and grazing, cover is sparse and is made up chiefly of several species of Restionaceae and Gramineae and scattered shrubs of which the most frequent are *Leucospermum attenuatum*, *Euclea polyandra* and *Passerina sp.* A typical specimen of *S. alexandri* in such a locality is shown in Plate I, Fig. 1. All the trees of this group were erect and about 10 ft. high with coppicing shoots at the base of the trunk and occurred from 3 to 30 ft. away from each other. Within the area of the group underground stems, evidently exposed by erosion, were seen; they were about 6 inches in diameter and had the characteristic smooth silvery bark and evenly spaced lenticels of *S. alexandri*. A careful examination showed that undoubtedly some of the trees in the group were offsets of the same underground system and not separate individuals as would seem to be the case from a first casual inspection. Before discussing this peculiar form of growth it is as well to describe the other extreme form which is to be seen at Van Stadens west of Port Elizabeth.

The Van Stadens Mountains are a more southerly extremity of the coastal fold belt than the Winterhoek Mountains, but are also formed by the Table Mountain Series. In general, the climate is more temperate than at Uitenhage and the annual rainfall higher, the average for a period of twenty years at Van Stadens being 30·55 inches, while for the same period at Uitenhage it was 18·25 inches (Schönland). Where the Van

Stadens River flows through a deep gorge, there is quite an extensive development of low temperate forest, the most frequent trees being *Lachnopylis floribunda*, *Brachylaena dentata*, *Gonioma kamassi* and *Curtisia faginea.* Amongst such trees and not far from the river margin a few small groups of *S. alexandri* are to be found. Under these conditions its growth might be described as decumbent, since long trunks lying close to the ground give rise to laterals which grow out at all angles but whose branches eventually contribute to the general foliage of the canopy above. A photograph of a typical specimen of this habit is given on Plate II.

These differences in habit are constantly associated with differences in the height of the surrounding vegetation for in the macchia-like bush which forms a transitional community between open veld and fragments of temperate forest as, for example, in the valleys of the Winterhoek Mountains, intermediate forms between these two extremes occur; in fact, it is here that the most vigorous trees are to be found. Hence it would seem that the growth form of *S. alexandri* is highly plastic, being influenced chiefly by the physical conditions associated with differences in the density and height of the surrounding vegetation. When exposed to high light intensity and sudden fluctuations of humidity the main horizontal branches are apparently developed underground, but when protected by a high canopy of other vegetation giving reduced light intensity and more even humidity the main horizontal branches occur above ground.

The colour of the flowers also varies considerably according to the light intensity. Trees on open hill slopes have yellow flowers with a rich claret-coloured throat (Plate I, Fig. 2), while those in bush or in forest have pale greenish-cream flowers with only a few flecks of red. The flowering period is apparently dependent to a large extent on the rainfall. Schönland and MacOwan both collected flowering material in January; Drege in August; this year (1950) after a prolonged drought followed by good rains the trees in both localities were flowering in May and June. During the first part of the season the flowers were mostly male by abortion of the carpels (Archibald), later fully developed bisexual flowers were formed, sometimes two or three occurring on the same inflorescence, but many of these dropped when unusually hot days occurred shortly after they had opened. Even under favourable conditions it is seldom that all five follicles mature so that the total production of seed is not great. Judging from the remains of old fruits below the trees those growing in bush and forest are more fertile than the ones growing in exposed situations. All these factors indicate that the species thrives best in the mixed community of the forest margin.

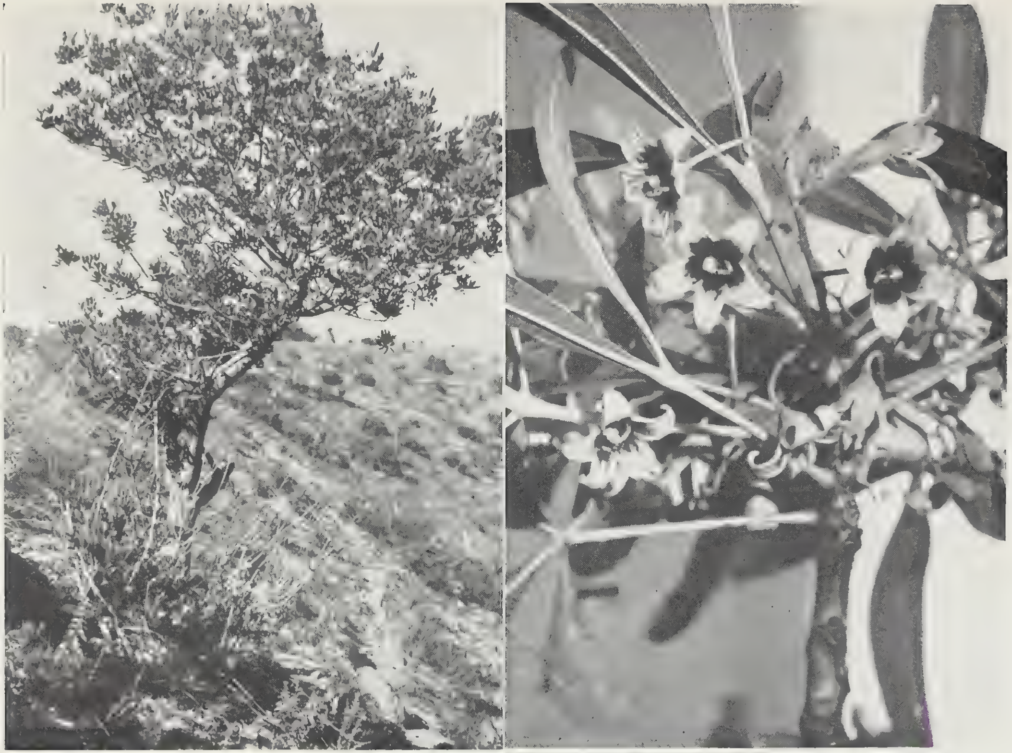

PLATE I. FIG. 1.—*Sterculia alexandri* growing on an exposed slope in the Winterhoek Mountains.
FIG. 2.—Flowering shoot of *S. alexandri* from a tree growing in an exposed position. ($\frac{3}{4}$ natural size).

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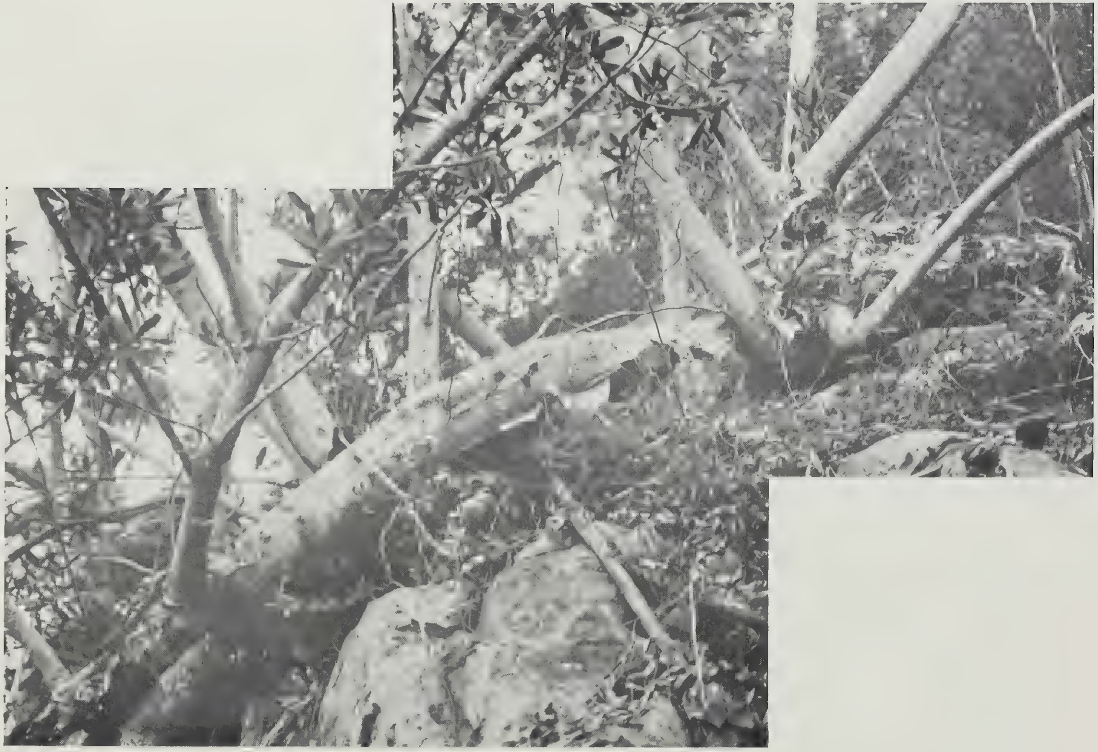

PLATE II. *Sterculia alexandri* growing in low temperate forest at Van Stadens.

Seeing these trees in their natural surroundings one gains the impression that the groups are all old-established ones, although the suckers are of varying ages from young ones of the previous year to well developed tree trunks of 9 inches or more in diameter. No young trees, that could not be associated with an older underground system, or seedlings were seen and this is not altogether surprising since in both localities baboons are very prevalent and are known to eat the ripe seeds. However, although peculiar in its habit and restricted in its natural distribution, the species should be in no danger of extinction since it has been found that it can be readily propagated from cuttings.

With regard to plants in cultivation, I have been told that a single specimen was successfully raised from seed by Mr. Cartwright at the Magennis Park, Uitenhage. Apparently it flowered and bore fruit regularly each season and had reached a height of 20 ft. or more before it died during the severe drought of 1948-49. At the National Botanic Gardens, Kirstenbosch, there are three fine trees also raised from seed, sent by Mrs. T. M. Paterson from Kamaehs, near Uitenhage, and now about 31 years old. When I inspected them with Professor Compton early in October 1950, they each bore several fine clusters of green fruit, as they were said to have done for several years. In our own garden at Walmer we set cuttings in June and July 1950, two from underground parts and two from aerial branches, taken from the trees in the Winterhoek Mountains and the Van Stadens Gorge, respectively. Three of these cuttings took successfully and for the past six months have done well.

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NOTES ON THE CHROMOSOME MORPHOLOGY OF THE GENUS GIBBAEUM HAW.

By Miriam P. de Vos.

Before his death, Professor G. C. Nel was working on a systematic revision of the genus Gibbaeum Haw. and had already visited many of the type localities to collect specimens which he brought to the Botanic Gardens of the University of Stellenbosch for cultivation. The Gibbaeum collection in the garden is now almost complete, nearly all the described species being represented. Professor Nel was of opinion that a knowledge of the incidence of polyploidy might be helpful in elucidating some of the taxonomic problems in the genus. Such an investigation has already been done by Wulff (1944) who studied the chromosome morphology of a large number of Gibbaeum species from the Botanic Gardens of Kiel. But Wulff does not state for what length of time the specimens used by him have been cultivated; and as there is a slight possibility that plants may become polyploid under cultivation, Nel thought that the specimens in the Stellenbosch garden should be used for reinvestigating the occurrence of polyploidy in the genus. Many of these specimens are the original ones collected by him from the type localities and other habitats. Furthermore, the collection in this garden offers a good opportunity for studying the occurrence of intraspecific polyploidy, as some of the species, e.g. *G. cryptopodium*, are represented by material collected from different localities.

In view of such considerations the present author therefore undertook the work of reinvestigating the occurrence of polyploidy in the genus.

Actively growing root-tips were obtained from slips placed in vermiculite for some weeks. The author's thanks are due to Mr. H. Herre and Mr. H. Meyer of the Stellenbosch Gardens for supplying the material. The root-tips were fixed in 2BE and transverse sections, cut 10μ in thickness, were stained with Heidenhain's iron-alum haematoxylin. As many root-tips as possible were examined from each species, to prevent confusing local somatic polyploidy with generative polyploidy.

The results are tabulated below, the diploid species being given first.

In this investigation mitotic divisions in 20 Gibbaeum species have been examined. The large majority of species was found to be diploid, 4 tetraploids being found and only one hexaploid occurring. The chromosome numbers of the four species *G. blackburnii*, *G. cryptopodium*, *G helmiae* and *G. fissoides* and of the *Muirio-Gibbaeum* hybrid are now

Name of Plant.	2x Chromosome Number.	Locality.
Gibbaeum album N.E.Br.	18	Locality unknown
G. blackburnii L. Bolus	18	Calitzdorp, Oudtshoorn Div.
G. comptonii L. Bolus	18	Perdefontein, Montagu Div.
,,	18	Klein Swartberg, Ladismith Div.
G. cryptopodium (Kensit) L. Bolus	18	Witvlak, 21 mls. from Ladismith
..	18	Ockertskraal, Ladismith Div.
..	18	Immelman's farm, Ladismith Div.
..	18	Calitzdorp, Oudtshoorn Div.
..	18	Road to Barrydale, Ladismith Div.
,,	18	Rooihoogte, Ladismith Div.
G. dispar N.E.Br.	18	Van Wyksdorp, Ladismith Div.
G. fissoides (Haw.) Schwant.	18	30 mls. from Warmbad, Swellendam Div.
..	18	Allemorgens, Montagu Div.
..	18	Immelman's farm, Ladismith Div.
G. heathii (N.E.Br.) L. Bolus	18	Calitzdorp
..	18	Algewynskraal, Ladismith Div.
..	18	Stofkraalnek, Ladismith Div.
..	18	Warmbad, Swellendam Div.
..	18	21 mls. from Ladismith
.. var. major L. Bol.	18	Ockertskraal, Ladismith Div.
G. helmiae L. Bolus	18	Zebra, George Div.
G. luckhoffii L. Bolus	18	Perdefontein, Klein Karroo
G. nebrownii (N.E.Br.) Tisch.	18	Habitat unknown
G. pachypodium (Kensit) L. Bolus	18, 36	Ockertskraal, Ladismith Div.
G. perviride (Haw.) N.E.Br.	18	Immelman's farm, Ladismith Div.
..	18	Touwsriver, Worcester Div.
,,	18	Ratelfontein, Swellendam Div.
G. petrense (N.E.Br.) Tisch.	18	Springfontein, Riversdale Div.
G. pilosulum N.E.Br.	18	Barrydale rd., 15 mls. from Ladismith
G. pubescens (Haw.) N.E.Br.*	18	Lemoenhoek, Swellendam Div.
,,	18	Allemorgens, Montagu Div.

*These species have also been investigated before by the present author (1947).

Name of Plant.	2x Chromosome Number.	Locality.
G. angulipes (L. Bolus) N.E.Br.	36	Habitat unknown
G. geminum N.E.Br.	36	Bellair Dam, Swellendam Div.
,,	ca. 54	Road to Barrydale, Ladismith Div.
,,	ca. 54	Klein Karroo
G. schwantesii (N.E.Br.) Tisch.*	36	Fisantefontein, Riversdale Div.
G. shandii N.E.Br.	36	8 mls. from Warmbad, Swellendam Div.
G. velutinum (L. Bol.) Schwant.*	36	Habitat unknown
× Muirio-Gibbaeum sp. N.E.Br. (Gibbaeum album(?) × Muiria hortenseae N.E.Br.	18	Springfontein, Riversdale Div.

*These species have also been investigated before by the present author (1947).

recorded for the first time, those of the other species having previously also been studied by Wulff (1944). Together with the latter's results this investigation brings the total number of Gibbaeum species examined for their chromosome morphology up to 23 out of a total of 27 described species (Jacobsen, 1938). (Prof. Nel thought that some of the abovementioned species should be united. For the present the old specific names have been used, as enumerated by Jacobsen.)

Both Wulff's and the present results show that there is a remarkably low percentage of polyploid species in the genus, considering the semi-arid conditions under which the plants exist. It is evident that the formation of new species through polyploidy has not taken place to any great extent in the genus. Even the *Muirio-Gibbaeum* specimen which is considered by N. E. Brown to be a hybrid and which could be expected to show polyploidy, is diploid.

The chromosome numbers of 12 species reinvestigated by the present author agree with Wulff's results. In *Gibbaeum geminum*, however, an intraspecific variation in the degree of polyploidy has now been found, plants from two localities being hexaploid and those from a third locality, the Bellair Dam, being tetraploid. Wulff found the Kiel material of *G. geminum* to be hexaploid only. The occurrence of hexaploid and tetraploid individuals indicates two possible modes of origin for the species:

the hexaploid specimens from triploid and the tetraploid ones from diploid parents.

In two other species different chromosome numbers have now been found: in *G. pachypodium* all the root-tips examined except one, proved to be diploid, the exception being tetraploid; and a root-tip of *G. angulipes* showed the tetraploid chromosome number. The latter is the only species where only one root-tip could be obtained for study. Wulff (1944) found the former to be tetraploid and the latter diploid. Apparently, therefore, intraspecific polyploidy occurs in these two species. On the other hand it is possible that the tetraploid root-tips are cases where doubling of the chromosome number had taken place in the root initials in diploid plants. If this is so, the species *G. angulipes* and *G. pachypodium* should be considered as diploid.

The occurrence of tetraploid chromosomal chimaeras in the periblem of some of the diploid root-tips also indicates that there is a tendency in the genus for somatic cells to become polyploid. In *G. fissoides* and *G. heathii* the present investigator found a root-tip with a tetraploid chimaera, the tetraploid sector covering one-quarter to one-third of the periblem in the transverse section. The plerome, however, remains diploid. These tetraploid cells show no somatic pairing of any of the homologous chromosomes. Wulff (1940) also found no pairing in the metaphase of a tetraploid cell in *G. molle*, but in *G. heathii* var. *elevata* L. Bolus and in *G. dispar* he found a high degree of pairing of the homologous chromosomes in the prophasic and metaphasic stages in tetraploid cells. He concludes that such polyploid somatic cells arise from a double longitudinal splitting or "innere Teilung" of the chromosomes, probably before the prophase sets in.

The presence of polyploid chimaeras and polyploid root-tips shows how careful investigators should be when making use of root-tips for determining the existence of generative polyploidy. Large numbers of root-tips should be examined and many cell-divisions in all parts of the root-tip should be observed.

With one exception there seems to be no connection between polyploidy and the size of the leaves in Gibbaeum. At the time when this investigation took place the plants were not in flower. No statement can therefore be made about polyploidy and the size of the flowers or fruits. In some of the polyploids the leaves are large, e.g. in *G. velutinum*, *G. schwantesii* and *G. shandii*, but in others, e.g. the tetraploid and hexaploid individuals of *G. geminum* they are very small. The hexaploid individuals have slightly bigger leaves than the tetraploid specimens of the same species. This is the only instance where any correlation was found to occur between the degree of polyploidy and the leaf size. Many of the diploids have small globose leaves, but others possess large and very succulent leaves, e.g. *G. heathii* var. *major.*

When the root periblem, however, is partly diploid and partly tetraploid, the tetraploid sector is wider than the diploid and the plerome is therefore excentric. This increase in width is caused by the bigger tetraploid cells; the nuclei of these cells also are bigger than those in the diploid parts.

Wulff (1944) also found no correlation between polyploidy and leaf size, but he observed a correlation between tetraploidy and the degree of succulence, the tetraploids being more succulent than those diploids closely related to them. He states that *G. shandii* is more succulent than the closely related diploid *G. pubescens* and that *G. luteoviride* is more succulent than *G. perviride.* The material in the Stellenbosch garden hardly verifies this: the specimens of *G. luteoviride* and *G. perviride* here show the same degree of succulence and those of *G. shandii* are only slightly more succulent than *G. pubescens. G. haagei* which Wulff considers to be more succulent than *G. petrense,* is unfortunately not represented in the local garden.

The chromosomes are small and show no appreciable differences in size or structure within the complements. A slight variation in size occurs between the chromosomes of different species, those of polyploid species usually being smaller than those of diploids. In diploid and tetraploid sectors of the periblem the chromosomes are about equal in size.

In the polyploid species a larger number of actively dividing cells occur than in the diploids. This may mean that growth in polyploids is faster than in diploids, or that cell-divisions in the former take a longer time.

With the exceptions discussed above, this investigation on the chromosome morphology of the genus Gibbaeum bears out Wulff's results.

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BOOK REVIEWS.

THE SOUTH AFRICAN FUNGI AND LICHENS TO THE END OF 1945. By Ethel M. Doidge, M.A., D.Sc. Pp. 1094, 10 plates, 11 maps. Published as Vol. V for 1950 of "Bothalia." (Pretoria: The Government Printer. 30s.)

Dr. Doidge says that her aim has been "to assemble all available information about the fungi and lichens which are known to occur in Southern Africa or which have been recorded as occurring in the subcontinent, to record the hosts or substrata on which they are found, to indicate as far as possible their distribution and the publications in which reference to South African species has been made." But this fine and important work is far more than a mere compilation, for the information about 4,748 species has been carefully sifted, classified and indexed and she has written a most interesting background to it. This begins with an introduction in which the collections of fungi, lichens and myxomycetes available for study in southern Africa are briefly described. Then comes an account (with a coloured map) of the natural features and vegetation of Africa south of the 15th parallel, selected as the northern boundary for recordings. Against this is sketched in outline the relation of the fungi to the native vegetation. Plants in cultivation and their associated fungi are also discussed.

A "history of observations on the fungi and lichens of South Africa" follows, and this is a specially interesting section. As most of the plant collectors included some fungi and lichens, it becomes a very useful 26-page digest of the history of botanical exploration in southern Africa. Then comes an account, with illustrations, of eight fungi of special interest found by the early collectors. That remarkable Gasteromycete, *Secotium Guienzii*, is the first dealt with. Till this year, it had only been found four times since its discovery in 1840, so it is pleasant to be able to record here that the abnormally heavy rainfall of late April, 1951, at the Cape brought it up in three new localities, in the Tygerberg hills, in the Caledon division and near Riet Vlei in the Cape division.

Fungi on hosts other than vascular plants (on fungi, lichens, insects, fish, domestic animals and man) are next considered and two unworked lines are pointed out—the aquatic Phycomycetes often seen infesting our freshwater algae and the Laboulbeniaceae which are surely present on some of our aquatic insects. This is followed by a miscellany of all sorts of interesting observations on the different groups of fungi as represented in southern Africa. Regarding the Agaricaceae, Dr. Doidge says: "A study of this group will only be effective when it can be carried out over a period of years by someone familiar with species occurring in other parts of the world." For local areas however it may be possible to employ the method used by Mr. A. A. Pearson and the present writer, for the area within 40 miles of Cape Town. Mr. Pearson came here for the autumn of 1948 and was able to identify 119 agaric species and describe 35 new ones in the two-and-a-half months of his stay. Since his return, he has been able to identify or name as new 26 others from material supplied by the writer; this requires a painting, full description, and drawings of microscopical characters, as well as the dried specimen.

The List of Species occupies 655 pages. It is introduced by an explanation of the abbreviations used, and here Dr. Doidge has supplied a most useful feature, a list of 670 authors' names with dates and the standard abbreviation of each name; the list being arranged alphabetically by these abbreviations. For each species there is a full list of literature references and all its recorded localities for southern Africa. That is to say, all that could be collected from published records and from the collections at Kew and in southern Africa, the list being compiled during 1939–1945 when continental herbaria could not be consulted and the British Museum types had been stored for safety. In the locality records, hosts are given for all parasitic species, and a Host Index arranged by families (with its own alphabetical index) occupies another 227 pages. A Locality Index follows, giving district and province or territory for each locality mentioned, and ten maps cover the area. The volume closes with a full Bibliography, a lengthy Index to the fungi and lichens, and a shorter one to the botanists and collectors mentioned in the introductory sections.

In a compilation like this, a basis for future work, one does not necessarily look for critical accuracy in nomenclature, apart from the material that has passed through the author's own hands (in this case a large proportion of the Ascomycetes, as well as the rusts and other disease-producing fungi). The essentials are lists showing what species have been published, localities, literature lists, cross-references, indices; all most laborious and exacting work. These Dr. Doidge has given us, and in addition we have all the background of general information in the first 75 pages, so clearly presented and so interesting. The whole forms a monumental and most distinguished piece of work, a fitting coping-stone to her career as Senior Plant Pathologist. As Dr. Pole Evans says in his Preface, "She has tirelessly paved the way and truly laid the foundation on which mycology in southern Africa will be built."

EDITH L. STEPHENS.

THE LICHENS IN DR. DOIDGE'S LIST.

In 1894, Ernest Stizenberger, a Swiss medical doctor, geologist and lichenologist completed his list (with supplements) of all the lichens which, up to that date had been recorded for the continent of Africa and adjacent islands, including of course, all those species which had been recorded for South Africa.

Until the publication of the list now under review, no other comprehensive enumeration of South African lichens has appeared, so that the list of lichens in "The South African Fungi and Lichens" by Dr. E. M. Doidge (Bothalia, Vol. V, 1950) is indeed an important event in the history of South African lichenology and constitutes also a welcome addition to the literature of lichenology in general.

Stizenberger's list was arranged according to the system of classification devised by Nylander, but this system has long since been replaced by that of Zahlbruckner, whose recent publication "Catalogus Lichenum Universalis" (1922–1940) has given Dr. Doidge a firm basis for her work.

Primarily, the lichen list consists of those species which have been recorded for South Africa south of latitude 15°S. and includes for each species the author's name, place of publication of the South African record, a reference to Zahlbruckner's Catalogue and the habitat and locality where collected. Occasionally some synonyms are also included and for many of the more recent new species, the type collecting is indicated.

The value of any lichen list will depend, of course, upon the accuracy of the determinations and fortunately in the list under review it is usually possible by reference to the bibliography, to discover who has made them. However, it appears that a number of localities taken from herbarium sheets are here published for the first time and it is unfortunate that these are not indicated as such. Dr. Doidge has given herbarium numbers and the names of the herbaria where the specimens can be seen, so that if necessary it will be possible to re-examine them if suspect. In those cases in which the names of the lichenologists who have identified the plants are given, they may be regarded as reliable. Of the mass of unpublished South African material in Europe, no mention is made, as Dr. Doidge found it impossible to undertake this work.

One of the most interesting aspects of the lichenology of the Southern Hemisphere is the relationships of the lichen floras of the great southern continents to one another and to Antarctica and its surrounding islands and lichen plant-geographers have long felt the need for a new and modern list of the South African species to replace the long out-dated one of Stizenberger.

Owing to the extremely backward state of lichenology in South Africa, the lichen genera of this country which have received critical revision are only those in which South African species have been treated as part of a great world monograph, such as Wainio's "Cladonia," Darbishire's "Roccella" and Magnusson's "Acarospora" or Motyka's "Usnea." The result is that the plant-geographer will have to use Dr. Doidge's list with the very greatest care, as absence from the list does not mean that a plant is not to be found in South Africa, for the South African lichens have as yet been only most superficially collected, but even the presence of a name in the list cannot always be taken at its face value, for over the long period of years which the list covers (1771 to 1945) it is inevitable that some incorrect determinations have been included in the lists of both Stizenburger and Dr. Doidge. Nothing but a complete review of the whole of the recorded species and a critical examination of all the types (now scattered over various herbaria of Europe and even some in America) could produce a faultless list and many years will pass before this can be done. On the other hand, the list forms an excellent basis for the monographer to work from and will save him the many hours of tedious research which would be required to accumulate the scattered records which are here brought together.

As an example of the sort of critical revision which will have to be made before we have a completely reliable list for the use of the plant-geographer, we may take the records of the species of Siphula on p. 332. The list records seven species, all of which Dr. Doidge is entirely justified in including, as they have all previously appeared in print as South African plants.

Siphula ceratites Fr. is probably an error of transcription made by someone in Europe, as the duplicate specimen of the number (615) on which this record is based is in the van der Byl herbarium and is S. tabularis Nyl., a name which is also written against this number in van der Byl's manuscript number book.

Siphula decumbens Nyl. is a genuine record. Siphula Dregei, besides being a nomen nudum is also probably S. tabularis Nyl. Dr. Doidge lists the Drège lichens which are enumerated in Meyer's "Zwei pflanzengeographische Documente," Flora, Bd. 2 (1843), from which the record of S. Dregei is taken. Unfortunately, Zahlbruckner omitted all of these from his "Catalogus Lichenum Universalis." Siphula incrustans Vain. is only an early stage in the development of S. tabularis. Siphula minor Vain. is a nomen nudum published by van der Byl and is a shade form of S. tabularis. Finally Siphula tabularis Nyl. and S. torulosa Nyl. are well authenticated species and thus only three genuine species remain of the original seven listed.

In a general and unrevised list of species collected over a long period of years, one has to regard with caution some of the early records of lichens which resemble European species. The earlier workers tended to give them the names of previously described plants, but later and more critical and detailed investigations have frequently shown many of them to be distinct species. The other extreme, where every South African specimen has been named a "new species," is to be found in the work of Dr. K. Gyelnik, some of whose work under the genera Parmelia and Sticta is to be found in the list. To those who know something of the South African lichen flora in the field, it is obvious that most of his new species are merely epharmones. Nevertheless, these names will cause considerable trouble to those who attempt to revise his work. In America, many of Gyelnik's names are already being ignored, e.g. in E. C. Berry, "Monog. Gen. Parmelia in North America and Mexico" (1941).

A striking feature of the South African list is the large number of species in genera such as Lecanora, Lecidea and Buellia which are notoriously difficult and have never received a world revision. We may take as an example the genus Buellia, for which Dr. Doidge has recorded over 90 species and varieties. Of these, roughly about 58 per cent have been recorded only from South Africa and are based on a single collecting and about 5 per cent are similarly recorded for South Africa only, but are known from several localities. 37 per cent are known from other countries besides South Africa. Thus 63 per cent of the total recorded species of Buellia have been found in South Africa only, which would indicate for this genus a very high degree of endemism in a lichen flora which, on the whole seems to have relatively few endemic species and even fewer endemic genera. One is tempted to infer that in many cases it has been easier to describe a species as new than to discover with certainty whether it is or is not one already described. Only a world revision can elucidate the real value of these species and thus make possible a comparison of the South African flora with the floras of the remaining southern continents. It is of interest to compare the South African figures with those of another sub-continent having a great variety of climate, but where the flora is better known. We may take Bruce Fink's "The Lichen Flora of the United States" (1935), where the figures are: Buellia, 29; Lecidea, 71; Lecanora, 68. The corresponding figures for South Africa are 92, 111 and 82 respectively.

Several nomina nuda in the list will puzzle lichenologists who are not familiar with the history of lichenology in South Africa. The late Prof. van der Byl sent collections of lichens for identification to various lichenologists in both Europe and America. He also published a list of names and proposed names given to him by these lichenologists for the plants in his herbarium, a list unfortunately marred by numerous errors of various kinds, including several new name combinations which were evidently inadvertently made, as he attributed them to others. This herbarium list appeared in print (Ann. Univ. Stellenbosch, IX, 1931) before the descriptions of several lichens were published and as in some cases the descriptions were never published, owing to the deaths of Wainio and Merrill, the names remain nomina nuda. The specimens sent to Merrill are presumably in the Farlow Herbarium.

Little has escaped Dr. Doidge's search of lichen literature, but there are a few omissions of some importance. Massalongo's "Lichenes Capenses" (1861), contains a few new species attributed to the Cape, but Stizenberger discovered (Flora, Bd. 73 (1890) 184), by consulting Wawra's original journal and number book in Vienna, that they came in fact from Ascension. Thus Opegrapha Zanei Mass. and Chiodecton capense (Mass.) Zahlb. came originally from this island and the types are not from the Cape. Roccella Hereroensis Wain. was, on the evidence of the gonidia, shown to be an Usnea by Darbishire (Ann. Crypt. Exot. V (1932) 160) and was also treated as such by Motyka (Monog. Gen. Usnea (1938) 640).

Sufficient has now been said to indicate the very varied worth of the lichens recorded in the list, but it would be well to emphasize that most of the records it contains are lichens from the sea coast, or from inland areas of relatively low altitudes; the high mountain flora of South Africa is as yet almost unknown. It is in the higher altitudinal zones of 5,000 to 10,000 ft. that we may expect new discoveries to be made which are of importance to plant-geography and some very recent high altitude expeditions have already demonstrated this. Dr. E. Frey in a paper entitled "Neue Beiträge zu eine Monographie der Genus Umbilicaria" (Ber. d. Schweiz. Bot. Gesell., 59 (1949)) has recently added several new records and new species of Umbilicaria to the South African list, from material collected at high altitudes by Mr. E. Schelpe and Miss E. Esterhuysen. The ecological aspect is treated by Mr. Schelpe in "Observations on the Ecology of the South African Umbilicariae" (Jour. S.Af.Bot. Vol. XVI (1950) 39–45) where the habitats are described from personal observation.

Regarding the future of lichenology in South Africa, it may be said at once that until adequate collections can be built up in the South African herbaria, so as to provide the material for the monographer to work with, little or no advance can be made. One of the greatest bars to progress is that so much material has gone to Europe and so few well authenticated specimens have remained in South Africa. Even for the extensive collections made by MacOwan which form the basis of the South African material in Stizenberger's list, no duplicates remain in

South Africa, where they would obviously be of the greatest value. The original MacOwan collection is almost entirely at Zurich, but a few specimens determined by Stirton are in the Glasgow Museum.

Thus the lack of type material and of the necessary literature will for many years to come render the study of lichenology in South Africa a most difficult one, but all botanists owe a debt of gratitude to Dr. Doidge for her careful and thorough work in compiling this list and thus making a start with what is obviously the first step towards a fuller and more accurate knowledge of the lichen flora of South Africa.

S. GARSIDE.

ADAPTATION AND ORIGIN IN THE PLANT WORLD. THE ROLE OF ENVIRONMENT IN EVOLUTION. By Frederic E. Clements, Emmett V. Martin and Frances L. Long. Waltham, Mass. Chronica Botanica Co. (Johannesburg, Central News Agency). xiv+332 pp., 54 plates, some in colour. 1950. $6.00.

This is an account of work which was begun in 1900 and which was continued through many vicissitudes until 1945, when both Dr. Clements and Dr. Long died. The publication has been carried through by Mrs. Clements, who is herself responsible for many of the excellent illustrations.

Experimental stations were established at various altitudes (up to 12,000 ft.) on Pike's Peak and on the California coast and, by means of transplantation and artificial control of conditions, the effects of environment on plant form were studied. The work was, in fact, a continuation of the pioneer experiments of Gaston Bonnier on Alpine plants. The results of this study are disappointing from the point of view of the fundamental processes of evolution. They show, more intensively and extensively than in previous work of this kind, the modifications in form which are a direct response to environment; and they emphasize the fact that many supposed species, as judged by herbarium methods, are merely ecads resulting from the physiological adjustment of plastic organisms to their conditions of soil and climate. But they do not show how a "good" species, with all its range of ecads, can be changed into another "good" species. The plant world is not a continuum: no species is infinitely plastic and herbarium study, though often based on inadequate evidence, is not entirely futile or mistaken. "Natural selection" say the authors "does not operate upon the forms produced by adaptation, since they are immediately in harmony with the environment that produces them." This is true enough; but it throws no light on the origin of species. Though the authors use the words *origin* and *evolution* in their title, they do not go so far as to assert that forms produced by response to conditions are eventually fixed genetically; and though they speak of "fixation" they bring no proof, nor do they say in so many words, that this "fixation" is genetic.

The book is valuable from the point of view of morphogeny, though it does not elucidate the mechanism of evolution. It is welcome as witness to the experimental side of Clements' vast ecological studies, which have had so wide an influence on botanical thought.

R. H. COMPTON.

AN INTRODUCTION TO THE STUDY OF VIRUSES. By Kenneth M. Smith, F.R.S. Pitman's Microbiology Series. Pp. 106, 16 plates, 13s.

The first number in the Microbiological Series set a very high standard for its successors. If subsequent volumes should be of such a standard, they will be a great boon to all scientists who are endeavouring to keep abreast of advances in fields other than their own.

This small volume sets out to introduce the reader to the virus and it does so admirably and concisely. Starting with the first recorded case of smallpox in China, nearly 4,000 years ago, the book describes all the important advances right up to the use of the electron microscope and the modern antibiotics in the study of viruses.

The presentation of the material is excellent. The virus is the main theme and everything revolves around it. It is not segmented into plant and animal viruses and bacteriophages. It scorns these artificial divisions and treats viruses as a whole. While this of course means that the author assumes a certain scientific background on the part of the reader, this is entirely justified, as most people who read the book will have some scientific knowledge. The treatment of insect vectors is an instance of this. Even non-zoologists can follow the discussion with absolute ease.

Many interesting facts are brought home very clearly. For instance the fact that some viruses can be seen under a good microscope, as is the case with the virus causing polyhedral disease in certain insects, and the fact that tobacco virus sometimes occurs in concentrations of 0·2 per cent in the sap, are neatly brought to the reader's notice. For those who prefer something more thought-provoking than a mere series of facts, the role of the viruses in plant and animal cancers is discussed with clarity.

The chapter on electron microscopy, with its illustrations, is very informative. In the space of a few pages, the author gives a remarkably clear account of the electron microscope, its method of utilization and its uses. Most biologists will appreciate this as there is no doubt that the electron microscope will play an increasingly important role in biological research.

The book is most readable and the style of writing fluent, with the exception of the chapter on the Serology of Viruses. The author is indeed to be congratulated on the way in which he has co-ordinated so much information in so skilful a fashion.

K. H. SCHÜTTE.

PLANT VIRUSES AND VIRUS DISEASES. By F. C. Bawden, F.R.S. Third Edition. Waltham, Mass.: Chronica Botanica Co. (London, W.C.2; Wm. Dawson & Sons, Ltd.). Pp. 335, figs. 59. $6.00.

The fact that this is the third edition of this book is in itself a recommendation for its contents. It is the ideal volume for a comprehensive introduction to plant viruses. That does not mean that it reads like a dull text book. The ease and clarity of the style in which it is written make it a pleasure to read. Mr. Bawden did not make a rush-job of this publication, which shows every sign of neat and careful preparation, from well turned phrases to comprehensive references to the literature at the end of each chapter.

As our knowledge of viruses has increased rapidly during the last decade, this book must be more than a mere reprint of the 1939 edition and such is the case. All the subject matter has been brought up to date so far as is possible and an extra chapter has been added. These additions have been skilfully inserted into the old framework of the previous editions.

As well as clearly showing what is known about viruses, Mr. Bawden also points out what is not known; for instance, he devotes an entire chapter to the taxonomy of viruses, showing where and how any of the present systems of classification are incomplete or of little value. When it is borne in mind how big are the gaps in our knowledge of the viruses, a certain amount of speculation must be expected. While there is a very noticeable amount of this, the author always manages to keep his facts and his speculations apart; there is no danger of mistaking one for the other.

The fact is repeatedly brought home that physiology, especially the physiology of infected plants, has not been studied sufficiently to enable any real generalized information to be obtained. This unfortunately is retarding advances in the field of virus research.

There are very few noticeable flaws in the book. Perhaps it is possible to question Mr. Bawden's contention that the control of viruses diseases, by normal cultural practices, has not yet been widely tried out. It is certainly true for temperate zones, but in East Africa, on the O.F.C. plantations, great efforts have been made to combat Rosette disease in the groundnut by controlling the planting dates within very narrow limits.

The production of the book is good with the exception, in the copy sent for review, of the cutting and binding of the pages between pages 70–80. This was poor and has caused the printed matter to appear in rather unusual positions.

K. H. Schütte.

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A REVISION OF THE GENERA *PRISMATOCARPUS* AND *ROELLA*.

By R. S. Adamson.

The two genera of Campanulaceae, *Prismatocarpus* and *Roella*, are closely allied. Indeed without studying the method of dehiscence of the fruit it is not always possible to assign some of the species to one genus or the other. Along with the small endemic South African genus *Merciera*, these two occupy a somewhat isolated position in the family. Both are confined to southern Africa and are especially characteristic of the so-called "Cape" flora of the south-west coastal region of the Union of South Africa. Indeed, *Roella* has only one, or possibly two, species extending beyond the limits of the sclerophyll vegetation of the mountain ranges of the south-west Cape Province. *Prismatocarpus* has most of its species on the mountains of the south-west but has two which extend into the arid regions of the karroo and South West Africa and one which occurs in Rhodesia. This last is not very closely allied to any of the others and may be found to be generically distinct. There are records of species of *Prismatocarpus* from the Transvaal but these are open to some doubt and require confirmation.

As originally described by L'Héritier (Sert. Ang. 2. 1788) *Prismatocarpus* included all those members of Campanulaceae with regular flowers and a long narrow ovary. In 1830 it was restricted by A. DeCandolle (Monog. Camp. 57 & 163) and redefined as characterized by a 2-chambered ovary and a fruit with dehiscence by 5 longitudinal splits. Those plants with a 3-chambered ovary were transferred to the genus *Specularia* Heist. As restricted by A. DeCandolle the genus is a natural one with uniform features and a limited geographical range. His connotation has been generally accepted for the past century.

Roella was founded by Linnaeus in 1753 who then described two species, one of which has been shown not really to belong to the genus at all (cf. J. S. Af. Bot. 12. 107. 1946). His son added some further species.

Both genera were monographed by A. DeCandolle in 1830 (Monog. Camp.), and again in 1839 (DC. Prodr. 7.). Under *Prismatocarpus* A. DeCandolle recognized 12 species in 1830 and 17 in 1839. Under *Roella* he had 11 species in 1830 and 16 with a further 6 in an addendum in 1839.

Sonder in 1865 revised both genera for the Flora Capensis when he recognized 14 species under *Prismatocarpus* and 12 under *Roella*. Since that time no reconsideration of either genus has been undertaken though some species have been added to both genera from time to time. While by no means all the species described by previous authors have been upheld, the numbers recognized in the present account are 30 in *Prismatocarpus* and 25 in *Roella*. Of these 11 in *Prismatocarpus* and 3 in *Roella* are described for the first time. Some new varieties are also described.

The number of new species brought to light is to a large extent the result of more intensive investigation of the higher mountains in recent years. In this connection the collections made by Miss E. Esterhuysen of the Bolus Herbarium, University of Cape Town, have been especially valuable and have been the source of several new discoveries. It is certain that further exploration of the mountains and especially of the more isolated ranges will result in an increase in the number of known species. Indeed at present there exist cases of specimens which do not agree with any recognized species but of which material is insufficient for description.

Wherever possible the descriptions have been drawn up from an examination of living material. Certain features of these plants are apt to be obscured in the dried state. Plants which are clearly separable when living are sometimes very much alike dried. Such features as the position and colour of the leaves, the colour, shape and texture of the flower are often obscured in dried material.

In both genera the species have been grouped under series characterized by both vegetative and floral features. In *Prismatocarpus* two well-marked subgenera are recognized: this grouping was suggested by A. DeCandolle (DC. Prodr. 7. 442. 1839) but he treated the divisions as sections to which he did not give names.

In the course of this revision, in addition to the author's own collections, specimens and material from the following herbaria have been examined. The symbols for reference are those put forward by Lanjouw (Chron. Bot. 3. 1937 & 5. 1939).

Bolus Herbarium, University of Cape Town	BOL
Dept. of Botany, University of Cape Town	CT
South African Museum, Cape Town	CTM
National Botanic Gardens, Kirstenbosch	KIR
National Herbarium, Pretoria	PRE
Albany Museum, Grahamstown	GRA
University, Johannesburg	J
Royal Botanic Gardens, Kew	K
British Museum (Nat. Hist.), London	BM
University of Oxford	OXF
Botany School, Cambridge	CGE
Musée d'Histoire Naturelle, Paris	P
Conservatoire de Botanique, Geneva	G
Naturhistorika Riksmuseet, Stockholm	S

In addition reference has been made to the Linnaean herbarium in London and to the Thunberg herbarium in Uppsala.

Thanks are returned to the curators and staffs of the various herbaria for assistance both in investigations in the various institutions and for permitting the borrowing of sheets for examination. To the curator of the Bolus Herbarium especial thanks are due for arranging for the loan of material from other South African institutions and for many facilities in the course of the work.

In the quotation of records under the various species the collection in which it occurs is included. This has been found advisable as in several of the older collections it has been found that more than one species has been included under a number.

With very few exceptions the type specimens of the species have been examined. These are quoted separately.

Finally special thanks are returned to Captain T. M. Salter, R.N. (retd.), who has most kindly checked the Latin used in the diagnoses of new species.

Acknowledgment is made to the Fourcade Fund, University of Cape Town, for a grant towards the cost of publication of this Revision.

PRISMATOCARPUS.

L'Hérit. Sert. Ang. 2. 1788. *emend.* A.DC. Monog. Camp. 57 & 168. 1830.

Herbs or shrublets. Leaves small, simple, alternate or less often opposite. Flowers terminal or axillary, usually regular. Corolla longer than the calyx. Stamens free from the corolla, the filaments usually dilated and ciliate at the base. Style bifid. Ovary inferior, narrow, 2-chambered, with numerous ovules. Fruit dry, finally splitting from the top into five, the splits alternate with the persistent or deciduous calyx lobes.

Rather variable in habit. Many of the species more or less ericoid. In flower and other features allied to *Roella*.

The type species is *R. pedunculatus* (Berg.) A.DC (*P. roelloides* (L.f) Sond.).

KEY TO THE SUBGENERA.

1. Calyx lobes almost free: corolla campanulate or funnel-shaped: disc hemispherical: style shorter than the corolla .. .. .. 1. Euprismatocarpus

1. Calyx lobes distinctly connate: corolla hypocrateriform, the lobes not equal: disc flat: style much longer than the corolla .. .. 2. Afrotrachelium

Sub-gen. 1. Euprismatocarpus Adamson s-gen. nov.

Corolla campanulata. Lobi calycini fere liberi. Filamenta staminum basi dilatata ciliataque. Stylus corolla brevior. Discus hemisphericus.

Herbs, shrublets or woody plants, erect or sprawling. Flowers solitary or in a branched inflorescence, with bracts and usually bracteoles. Flowers regular. Calyx lobes almost free. Corolla campanulate or funnel-shaped, longer than the stamens or style. Filaments of the stamens dilated and ciliate at the base. Disc hemispherical, sometimes enlarged after pollination.

KEY TO THE SERIES.

1. Flowers in a leafless terminal inflorescence: bracts smaller than the leaves .. .. 1. FRUTICOSI

1. Flowers mostly axillary: bracts like the leaves or larger.

  2. Bracts larger than the leaves: flowers in heads or in an apparent raceme: shrubby perennials .. .. 2. STRICTI

  2. Bracts like the leaves: flowers usually axillary, solitary: small or prostrate plants .. .. .. 3. NITIDI

Series 1. FRUTICOSI.

Perennes vel annuae. Folia alterna saepe conferta. Inflorescentia terminalis aphylla saepissime ramosa, bracteis subulatis vel linearibus foliis minoribus. Flores saepissime pedicillati.

Perennials usually woody at the base, or annuals. Leaves linear, often crowded. Inflorescence terminal, branched, with long internodes and very small linear or subulate bracts. Flowers usually pedicillate.

KEY TO THE SPECIES.

1. Perennials: leaves crowded.
  2. Ovary and calyx densely hairy: flowers clustered 2. *altiflorus*
  2. Ovary and calyx glabrous: flowers distant.
    3. Leaves lanceolate, dentate, decurrent .. 6. *decurrens*
    3. Leaves linear, entire, not decurrent.
      4. Calyx lobes as long as or longer than the corolla tube.
        5. Calyx lobes flat: corolla widely funnel-shaped; inflorescence branches stout.. 1. *pedunculatus*
        5. Calyx lobes subulate or very narrow: corolla campanulate: inflorescence branches slender.
          6. Inflorescence much branched: corolla dark outside: fruit very narrow: leaves usually ascending.. 3. *fruticosus*
          6. Inflorescence little branched, the flowers apparently racemose: corolla concolorous: fruit swollen: leaves short, squarrose .. .. 4. *lycopodioides*
      4. Calyx lobes shorter than the corolla tube.
        7. Calyx lobes very narrow, usually inrolled: corolla darker outside.. .. 3. *fruticosus*
        7. Calyx lobes flat, not inrolled; corolla concolorous.
          8. Calyx constricted below the lobes: corolla white or pale blue: inflorescence with slender branches .. 5. *brevilobus*
          8. Calyx not constricted: the lobes connate: corolla deep blue: inflorescence with few branches or the flowers sessile .. .. .. 7. *alpinus*
1. Annuals: leaves few, scattered.
  9. Leaves undulate: inflorescence branches divaricate: corolla divided almost to the base .. 8. *crispus*
  9. Leaves flat: inflorescence branches ascending: corolla tube as long as the lobes .. .. .. 9. *Hildebrandtii*

1. **P. pedunculatus** (Berg.) A.DC. in DC. Prodr. 7. 443. 1839.

Roella pedunculata Berg. Descr. Pl. Cap. 42. 1767. *Campanula pedunculata* Gmel. Syst. Nat. 2. 352. 1791. *P. paniculatus* L'Hérit. Sert. Ang.

2. 1788. *P. interruptus* L'Hérit. l.c. *P. roelloides* (L.f.) Sond. Fl. Cap. 3. 586. 1865. *Polemonium roelloides* L.f. Supp. Pl. 139. 1781. *Retzia roelloides* Spreng. Syst. 1. 589. 1821. *P. grandiflorus* A.DC. in DC. Prodr. 7. 443. 1839. *Roella ericoides* Spreng. Syst. 1. 723. 1825. *non* Buek *nec* Good.

An erect, diffuse or sprawling shrublet, 15—60 cm. high. Stems more or less woody, shortly hairy or rarely glabrous, branched mostly from the base. Leaves usually crowded, 0·7—2 cm. long, 2—4 mm. wide, flat, usually somewhat revolute, coarsely ciliate at least at the base, often with stout hairs on the broad and slightly projecting midrib. Axillary tufts of small leaves usually present. Inflorescence terminal, the peduncle glabrous, rather stout, variable in length: branches few or many, often almost divaricate. Flowers few or many, occasionally clustered but commonly distant. Bracts like the leaves but smaller, distant, concave above. Calyx lobes linear, 0·5—1 cm. long, 1—2 mm. wide, glabrous or less often ciliate, as long as or longer than the corolla tube. Corolla pale blue, violet or white, widely funnel-shaped or almost rotate, 1—2·5 cm. long, divided to more than half-way, the lobes acute. Ovary glabrous. Fruit 1·5—3 cm. long.

Flats and lower mountain slopes. Most common on sand. Widely spread through the western and south-western districts.

Variable in size, habit, leaf arrangement, extent and branching of the inflorescence, also in the size of the corolla and length of the calyx. The variations seem in part correlated with habit and in part to represent definite races. While the extremes appear very different they are connected by all stages of intermediate. In very general terms two forms are distinguishable, the one with ciliate calyx lobes not longer than the corolla tube, the other with glabrous lobes usually longer than the corolla tube. In his original description Bergius described a plant of the first form. L'Héritier and Linnaeus fil. on the other hand described the second and commoner form. As the two merge completely no separation is possible.

P. interruptus is merely a state of dry or exposed habitats with a short peduncle and almost sessile sometimes clustered flowers.

P. grandiflorus has larger flowers but no other constant feature of difference. It is a form from sandy soils in the northern districts.

VAN RHYNSDORP: Rd. to Calvinia *Esterhuysen* 736 (BOL). CLANWILLIAM: Clanwilliam *Levyns* 1341 (CT.); *Pillans* 8709 (BOL), 8772 (BOL, K, KIR, PRE): Donkerkloof *Leipoldt* 570 (BOL. K, PRE); *Stokoe* (CTM); Krakadouw *Leipoldt* 570, 571 (CTM); Olifants River *Esterhuysen* 1299 (KIR): *Pearson* 5280 (BOL. K) 7202 (BOL, CTM); *Stephens* 6379 (CTM); Hex River *Adamson* 4024: *Pearson* 5250 (BOL); *Pillans* 9060 (BOL); Greys Pass *Adamson* 4399; *Godman* 779 (BM);

Esterhuysen 7135 (BOL); *Pearson* 3524 (BOL), 5126 (BOL, K), 5280 (K); Warm Baths *L. Bolus* (K). PIKETBERG: Piketberg *Drège* (G); *Bolus* 13667 (BOL, PRE); *Guthrie* 2653 (BOL); *Pearson* 7120 (BOL); *Pillans* 7915 (BOL, K), 8587 (BOL, PRE), 8618 (BOL, K, KIR, PRE); De Hoek *Compton* 15002 (KIR, PRE). MALMESBURY: Darling *Bolus* 4304 (BM, BOL, K); *Drège* 6329 (BM, CGE, G, K, P, S) s.n. (PRE); *Levyns* 3276 (CT). CERES: Schurfteberg *Esterhuysen* 14720 (BOL); Cold Bokkeveld *Schlechter* 10181 (BM, BOL, GRA, K); Ceres *Liebenberg* 4322 (PRE); Michells Pass *Bolus* 5104 (BOL, K); *Compton* 10056 (KIR); *Esterhuysen* 14139 (BOL); *Hafstrom & Acock* 2007 (PRE, S); Mosterts Hoek Twins *Esterhuysen* 9914 (BOL); *Wasserfall* 806 (KIR); Wolseley *Schlechter* 9050 (S), 9070 (BM, G, GRA, K, P, PRE, S). TULBAGH: Tulbagh *Ecklon & Zeyher* (CTM); Witzenberg *Adamson* (CTM); Waterfall *Ecklon & Zeyher* (S); *Zeyher* 1077 (BM, CGE, CTM, K, P, PRE, S); Roodesand *Drège* 6329 (G, BM, K, CGE, S, P, PRE); Steendal *Zeyher* (CTM). WORCESTER: Worcester *Ecklon & Zeyher* 2391 (CTM), 3146 (CTM), sn (S); *Fine* G72 (PRE); *Story* 3594 (PRE); *van Breda* 181 (PRE, K); *Zeyher* (CTM); Hex River Mts. *Davidson* 16 (CTM); *Rehmann* 2474 (K); Keeromsberg *Esterhuysen* 9220 (BOL, PRE); Bonteberg *Compton* 9947 (KIR); *Esterhuysen* 3662 (BOL, PRE); Breede River *Drège* (G, P, S); *Ecklon & Zeyher* 3 (S); Goudini Road *Levyns* 4421 (CT); Blaauwkop *Esterhuysen* 19643 (BOL). CAPE: Klipfontein *Ecklon & Zeyher* (CTM); *Zeyher* (CTM). CALEDON: Houwhoek *Bowie* (BM); Villiersdorp *Bolus* 5103 (BOL); *Esterhuysen* 4400 (BOL, KIR, PRE); Genadendal *Ecklon* (S); Sondereinde Mts. *Esterhuysen* 4486 (BOL, KIR, PRE); *Ecklon & Zeyher* 3146 (CTM); *Schlechter* 5630 (GRA); *Zeyher* 3145b (P), 3146 (K, P, PRE, S). BREDASDORP: Elim *Bolus* 8573 (BOL); Appelkraal *Stokoe* 9380 (BOL); Kathoek *Esterhuysen* 4448 (BOL, KIR, PRE). ROBERTSON: Bushmans River *Levyns* (BOL); *Lewis* (KIR); McGregor *Esterhuysen* 4465 (BOL); nr. Storms Vlei *Esterhuysen* 4463 (BOL, KIR). MONTAGU: Barriedale *Levyns* 558 (CT). SWELLENDAM: Swellendam *Ecklon & Zeyher* 3146 (CTM), sn (S); *Galpin* 4309 (BOL, GRA, PRE); Buffelsjaagts *Zeyher* 3145 (CTM, K, P, S), 3145a (P); Storms Vlei *Esterhuysen* 4469 (BOL); *Compton* 5733 (KIR); *Levyns* 3475 (CT); Zuurbraak *Levyns* 558 (CT); Bushmans River *Walgate* 345a (KIR); Bonnievale *Marloth* 11840 (PRE). RIVERSDALE: Riversdale *Muir* 2781 (PRE.). ALEXANDRIA: Alexandria *Galpin* 10836 (PRE). WITHOUT LOCALITY: *Auge* (BM); *Burman* (G); *Ecklon* (OXF); *Ecklon & Zeyher* 94; 11 (GRA), 2390 (OXF, PRE), 2391 (P); sn (CGE); "*Hort. Kew*" (BM); *Lambert* (S); *Masson* (BM); *Moquin* (P); *Moricaud* (P); *Niven* (BM); *Oldenburg* (BM); *Pappe* (K); *Ryder* (K); *Thunberg* (S); *Verreaux* (BM, G, P); *Wallich* (K); *Zeyher* (S), 1077 (BM, CGE, CTM, G, K, P).

2. **P. altiflorus** L'Hérit. Sert. Ang. 2. 1788.

Stems slender, often weak though slightly woody at the base, up to 1 m. high, unbranched or branching from the base: young stems covered with very short hairs mixed with fewer coarse white ones. Leaves scattered, linear-lanceolate, 1—1·5 cm. long, revolute, coarsely ciliate and with coarse stout hairs on the midrib below, most often with axillary fascicles of small leaves. Inflorescence unbranched or with few short branches: peduncle stout, erect, glabrous, 3—50 cm. long, with scattered bracts 2—5 cm. apart, the uppermost with flowers in the axil. Flowers sessile or nearly so, the terminal in groups of three, the lateral solitary. Bracts linear about 1 cm. long, hairy. Calyx and ovary densely covered with spreading hairs. Calyx lobes lanceolate, 5—6 mm. long. Corolla cup-shaped, 1—2 cm. long, blue, pale violet or white. Ovary about 1—1·5 cm. long. Fruit 3—4·5 cm. long.

Rather rare on sandy soils at low altitudes in the northern areas.

The type is *Masson* in herb Brit. Mus.

A very distinctive species. The stems are commonly supported by surrounding bushes.

Clanwilliam: Keerom *Pillans* 8731 (BOL, CTM, K, KIR, PRE); *Esterhuysen* 17844 (BOL). Ceres: Onderboskloof *Esterhuysen* 14304 (BOL). Without Locality: *Masson* (BM).

3. **P. fruticosus** L'Hérit. Sert. Ang. 2. 1788.

P. subulatus A.DC. Monog. Camp. 166. 1830. *Campanula subulata* Thunb. Prodr. Pl; Cap. 38. 1794. *P. Bergianus* Cham. Linnaea 8. 199. 1833. *Lightfootia ciliata* Spreng. Syst. 1. 809. 1825 *non* Sond.

A diffuse shrublet, much more slender than *P. pedunculatus*. Stems woody at least at the base, 10—60 cm. high, the younger minutely downy, covered with leaves above, bare below, the branches ascending. Leaves linear, 0·5—2 cm. long or more, spreading or more often ascending, often falcate, flat or concave above, usually inrolled and subulate, rounded below, glabrous except for short stout coarse cilia near the base, with or without axillary tufts of smaller leaves. Inflorescence leafless, much branched, terminal also sometimes from the upper axils, 5—50 cm. long. Peduncle glabrous, red or brown, bare or with a few small distant bracts, at the top bearing slender forking branches. Bracts 4—8 mm. long, subulate, glabrous or ciliate. Flowers solitary, pedicellate. Calyx lobes very narrow, 3—5 mm. long, acute, flat or commonly inrolled, glabrous or less often ciliate, shorter than the corolla tube, slightly spreading in the bud and in fruit. Corolla 0·6—1·5 cm. long, campanulate, white but brown or purple externally, the lobes usually somewhat shorter than the tube. Ovary glabrous. Fruit very narrow, 1—3 cm. long.

Common on dry mountain slopes in the western and south-western districts. Flowers most freely in open places or after fires.

The type is *Masson* in herb B.M. L'Héritier regarded *Campanula fruticosa* L. Sp. Pl. 168. 1753 as synonymous with his species. This is a doubtful species which many have considered as a *Lightfootia* and as not belonging to this genus. There is no Linnean specimen.

Variable in height, branching of the inflorescence and in flower size. The size of the leaf and the presence or absence of axillary tufts are dependent on season and on habitat. There are no satisfactory features by which either *P. subulatus* or *P. Bergianus* can be separated. The variety *penicillatus* (*P. subulatus* var. *penicillatus* A.DC. in DC. Prod. 7. 444. 1839) cannot be maintained: the presence or absence of hairs on the corolla lobes is a very variable feature and one that does not seem to be correlated with other characters.

Distinguished from *P. pedunculatus* by the habit, involute leaves, slender inflorescence, and the calyx and corolla. Much like the two following species. Forms with short calyx lobes look very much like *P. brevilobus*. Plants growing in sheltered places at high altitudes may have an almost concolorous corolla.

CLANWILLIAM: Pakhuis Pass *Esterhuysen* 3710 (BOL), 7397 (BOL, PRE); *Leipoldt* 659 (CTM), 3709 (PRE), 3710 (PRE); Clanwilliam *Leipoldt* 4348 (KIR, PRE), sn (BOL); *Rogers* 16851 (BOL); Keerom *Esterhuysen* 17866 (BOL); Krakadouw *Adamson* 457; Crystal Pool *Esterhuysen* 4592 (BOL, PRE); Donkerkloof *Stokoe* (CTM); Juriesberg *Compton* 6253 (KIR); Vensterberg *Esterhuysen* 2546 (BOL); Uitkyk *Bond* 1417 (KIR); Elandsfontein *van Breda* 228 (PRE). CERES: Sneeuwberg *Esterhuysen* 12749 (BOL, KIR, PRE); Elands Kloof *Adamson* 1659, 3139; *Compton* 19454 (KIR); *Drège* 6327 (S.); *Esterhuysen* 4140 (BOL); *Levyns* 5097 (CT); *Stokoe* (CTM); Olifants River Mts. *Esterhuysen* 13375 (BOL, K, PRE); Cold Bokkeveld Mts. *Adamson* 1569 (CT, PRE), 4109, 4112, 4114, 4119, 4122, 4123; *Compton* 12502 (KIR); Schuurfteberg *Lewis* (CTM); Hansiesberg *Compton* 16686 (KIR); Baviaansberg *Compton* 12846 (KIR); 12853 (KIR); Gydo Pass *Esterhuysen* 3954 (BOL); Visgat *Esterhuysen* 13431 (BOL, PRE); Michells Pass *Wall* 18, 82/39, 84/39 (S.); Zandfontein *Barker* 4467 (KIR); Laken Vlei *E. P. Phillips* 1977 (CTM). MALMESBURY: Mamre *L. Bolus* (BOL); *Galpin* 12627 (PRE); Riebeck Kasteel *Adamson* 4415; *Salter* 2011 (BM, BOL, K). TULBAGH: Witzenberg *Andreae* 191 (PRE); Klein Winterhoek *Esterhuysen* 13754 (PRE). LAINGSBURG: Tweedside *Marloth* 12098 (PRE); Witteberg *Compton* 2787 (BOL, K). WORCESTER: Hex River Mts. *Rehmann* 2594 (BOL), 2694 (K); *Stokoe* 3096 (PRE); *Tyson* 744 (CTM, PRE); Matroosberg *Marloth* 2366 (PRE); *E. P. Phillips* 1977 (CTM); De Doorns *Bolus* 13152 (BOL);

Fonteintjesberg *Esterhuysen* 8774 (BOL); Onklaarberg *R. H. Marloth* 110 (PRE); Worcester *Zeyher* 1078 (BM, G, K, P), 1078a (P), 2393 (S); Brandvlei *Rehmann* 2470 (BM); Bonteberg *Compton* 9951 (KIR); *Esterhuysen* 3650 (BOL); Du Toits Peak *Drège* (S); Du Toits Kloof *Drège* (G, P, S); *Esterhuysen* 14350 (BOL, PRE); *Tyson* (CTM); Bains Kloof *Bolus* 4058 (BOL); *Esterhuysen* 1983 (PRE); *Kies* (KIR); *Wall* 80/39 (S); *Walgate* 245 (KIR). PAARL: Wellington Sneeuwkop *Leipoldt* 641 (GRA); Witte River *Adamson* 4382, 4385; *Galpin* 12628 (K, PRE); Haalhoek Spitzkop *Esterhuysen* 13519 (BOL); Du Toits Kloof Pass *Adamson* 4330: Wemmershoek *Compton* 10129 (KIR): *Esterhuysen* 4049 (BOL, PRE), 11344 (BOL, PRE); April Peak *Esterhuysen* 4102 (BOL, PRE); *Leipoldt* 3710 (BOL, PRE); Berg River Hoek *Compton* 8355, 12976, 15634 (KIR) *Esterhuysen* 10082 (KIR, PRE): Franschhoek Pass *Adamson* 4086, 4089, 4092; Franschhoek *Guthrie* 2273 (KIR); *Rodin* 3074 (BOL): Drakenstein *Bolus* 4058 (BM); *Galpin* 10616 (PRE): *Tyson* (CTM); Alexanders Kloof *Wallich* (BM); Paarlberg *Tyson* 961 (BM, CTM); Hercules Pillar *Hafstrom & Acock* (S.); Salem *Galpin* (BOL). STELLENBOSCH: Eerste River *Zeyher* 3147 (CTM); Brakenfel *Acock* 150 (S); Bottelary *Acock* 19 (S); Stellenbosch *Garside* 677 (K); Jonkershoek *Esterhuysen* 11487 (BOL, PRE); Helderberg *Galpin* 12317, 12342 (K, PRE); Gordons Bay *Bolus* 9818 (BOL). CAPE: Melkbosch *Wasserfall* 170, 777 (KIR); Klipheuvel *Zeyher* 1078 (BM, CTM, K); Vygeskraal *Wolley-Dod* 181 (BM, BOL, K); Milnerton *Hafstrom* (S); Cape Town *de Castelnau* 368 (P); Raapenberg *Guthrie* 999 (CT); *Zeyher* 1078 (BOL); Table Mt. *Adamson* (CT), 2781; *Ecklon* (S); *Wahlberg* (S); Orange Kloof *Compton* 19387 (KIR); Chapmans Peak *Compton* 8480 (KIR): Noordhoek Mts. *Adamson* 2435; Vlaggenberg *Adamson* 1749, 2387; Tokai *Guthrie* 1501 (CT); *Wolley-Dod* 1966 (BOL); Wynberg *Burchell* 785 (K); Steenberg *Adamson* 3492; *Compton* 10297, 17882 (KIR); *Kensit* (CT); *Levyns* (CT); *Salter* 5945 (CT); Muizenberg *Bolus* 4652 (BOL); Simonstown *Adamson* 824 (PRE); *Bolus* 4653 (BM, K); *Moss* 7432 (BM); *Schlechter* 306 (BM, CGE, GRA, G, P, PRE); Klaver Valley *Adamson* 824: *Moss* 7505 (BM): *Salter* 292 30 (BM), 2041 (BM, K): Red Hill *Penfold* (KIR); Vogelfontein *Adamson* 3105; Smitswinkel *Adamson* 1589; *Compton* 15574 (KIR). CALEDON: Sir Lowry Pass *Adamson* 4157; *Hafstrom* (S); *Schlechter* 7274 (BM, G, GRA, K, P, S); Hottentots Holland *Pappe* (CTM); Houwhoek *Adamson* 4416; *Guthrie* 2273 (KIR); *Schlechter* 7375 (GRA); Paardekop *Stokoe* (CTM, PRE); Villiersdorp *Adamson* 4133; Stettynsberg *Esterhuysen* 11103 (BOL); Caledon *Bolus* (PRE); *Ecklon & Zeyher* 1078 (CGE, OXF, S), 2393 (S); *O. Kuntze* (K); *MacOwan* 3177 (CTM), sn (GRA); *Purcell* (CTM); *Verreaux* (G); Swartberg *Ecklon & Zeyher* 2373 (CTM); *Zeyher* 1078 (CTM, S.), 1078b (PRE); Genadendal

Burchell 7596 (K), 7969 (K); *Ecklon & Zeyher* 81 (S); *Drège* 6327(G, S), 6327a (CGE, G, K, OXF, P, S); *Gillett* 347 (BOL); Greyton *Gillett* 865 (BOL); *Stokoe* (CTM); Sondereinde River *Bowie* (BM); Stanford *Adamson* 4130. ROBERTSON: Sondereinde Mts. *Adamson* 4424, 4444. MONTAGU: Baths *Guthrie* 2762 (KIR); Wagenboomsberg *Compton* 10287 (KIR). UNIONDALE: Long Kloof *de Castelnau* 299 (P). WITHOUT LOCALITY: *Bowie & Cunningham* 113 (BM); *Harvey* 211 (BM, K); *Masson* (BM); *Oldenburg* 12 (BM); *Wallich* (G., K).

A specimen (*Rehmann* 5889 (BM)) is labelled "Houtbosch, Transvaal". The locality requires confirmation.

4. **P. lycopodioides** A.DC. in DC. Prodr. 7. 443. 1839.

P. subulatus var. *pauciflorus* Sond. Fl. Cap. 3. 587. 1865.

Stems many from a woody base, much branched, rarely over 10—15 cm. long, sprawling or forming small tufts or loose cushions. Leaves crowded, squarrose or the older reflexed, short, 3—4 or rarely up to 7 mm. long, linear, coarsely ciliate, most often fasciculate. Inflorescence slender, leafless, with few branches, the flowers 1—5, more or less racemose. Pedicels short, 2—5 mm. long. Bracts small, coarsely ciliate. Calyx lobes glabrous, very narrow, 3—5 mm. long, acute, keeled, longer than the corolla tube. Corolla white, rather delicate, widely campanulate, 0·5—0·6 cm. long, the lobes as long as the tube. Fruit rather swollen, glabrous, 1·3—1·8 cm. long, 2—3 mm. diam., usually green.

Among rocks on the upper parts of mountains in the Worcester-Paarl region.

The type is *Drège* 6328 in herb DC., Geneva.

Distinguished from *P. fruticosus* by the habit; the short squarrose leaves; the little-branched inflorescence with shortly stalked flowers; the small concolorous flowers with a delicate corolla; and the swollen fruits. From *P. brevilobus* it is separated by the calyx and fruit.

WORCESTER: Du Toits Kloof *Drège* 6328 (G); Du Toits Peak *Esterhuysen* 8598 (BOL, KIR); Bains Kloof *Schlechter* 9171 (BM, G, GRA, K, P, PRE). PAARL: Wemmershoek *Andreae* 775 (PRE); *Esterhuysen* 11381 (BOL, CTM, KIR, PRE); Seven Sisters *Esterhuysen* 13729 (BOL, K, KIR), 18319 (BOL); Banhoek Peak *Esterhuysen* 14363 (BOL).

Var. **hispidus** Adamson var. nov.

A typo differt caulibus longioribus erectis; foliis sparsis longioribus hispido-ciliatis; calyce et ovario breviter hispido; corolla campanulata tubo lobis longiore.

Stems erect, usually unbranched, hispid, up to 30 cm. high. Leaves scattered, fasciculate, linear, 0·4—0·8 cm. long, flat, slightly revolute, the edges and midrib below with many stout white rigid hairs. Peduncles glabrous. Calyx and ovary hispid with short white hairs. Calyx lobes 4 mm. long. Corolla campanulate, 0·6—1 cm. long, the lobes shorter than the tube. Fruit up to 2 cm. long, slightly swollen, more or less glabrescent.

Sand at the head of the Wemmershoek Valley.

The type is *Esterhuysen* 17661 in herb Bolus.

A much taller plant than the ordinary form with erect hispid stems in bunches. Leaves scattered, 0·3—0·5 cm. apart, hispid. Ovary densely covered with short stiff hairs when young but somewhat glabrescent in fruit.

PAARL: Wemmershoek *Esterhuysen* 17661 (BOL).

5. **P. brevilobus** A.DC. in DC. Prodr. 7. 443. 1839.

Stems branched, erect or procumbent, sometimes sprawling or almost tufted, woody at the base, the younger glabrous or covered with minute hairs usually mixed with some larger ones. Leaves linear, erect or incurved, sometimes secund or falcate, 1·5—3 cm. long, concave above, rounded below, rolled when dry, usually with coarse distant cilia, less often glabrous, often without axillary fascicles. Inflorescence slender, leafless, branched, the ultimate branches forking or racemose. Flowers pedicellate. Bracts very small, often deciduous. Calyx lobes 2—3 or rarely 4 mm. long, flat, subacute, usually glabrous, much shorter than the corolla tube, erect in the bud and in fruit. Calyx distinctly constricted below the lobes, most apparent at the time the corolla fades. Corolla funnel-shaped or rather widely campanulate, 0·5—1·2 cm. long, white, blue or white with blue markings concolorous, rather thin, the lobes shorter than the tube. Fruit very narrow, 1·5—2·5 cm. long.

Bushy mountain slopes or among rocks on the ranges along the west coast, not extending along the south coast.

The type is *Drège* 1949b in herb DC., Geneva.

Variable in size, in habit, and in the size of the corolla. Plants from high altitudes may have very short leaves and short decumbent or prostrate stems forming loose mats or cushions. While the extreme forms look very distinctive there are all stages of intermediate. Usually less branched than *P. fruticosus* and readily distinguished by the calyx and concolorous corolla of thinner texture.

CLANWILLIAM: Middelberg Plateau *Esterhuysen* 13795 (BOL, PRE); Sneeuwberg *Esterhuysen* 13820 (BOL, p. pte), 13823 (BOL, K, PRE). CERES: Cold Bokkeveld *Sir F. Gray* (K); Tafelberg *Stokoe* (CTM); Elands Kloof *Esterhuysen* 18446 (BOL); Schuurfteberg *Adamson* 3923; Gydo Pass *Isaac* (BOL); Ceres *Guthrie* (BOL); Valsch Gat *Esterhuysen* 4389 (BOL); Baviaansberg *Compton* 12883 (KIR); Laken Vlei *E. P. Phillips*

1976 (CTM). TULBAGH: Gt. Winterhoek *Galpin* 12620 (K, PRE), 12621 (K); *E. P. Phillips* 1795 (CTM); Kl. Winterhoek *Esterhuysen* 13753 (BOL, K, PRE), 19760 (BOL); Sneeuwgat *E. P. Phillips* (CTM). MALMESBURY: Mamre *Salter* 2076 (BM); *Penfold* 248 (KIR). WORCESTER: Hex River Mts. *Esterhuysen* 8738 (BOL); Mt. Brodie *Esterhuysen* 8751 (BOL); Matroosberg *E. P. Phillips* 1976 (CTM); Fonteintjesberg *Esterhuysen* 8765 (BOL); Waaihoek Peak *Esterhuysen* 8630 (BOL), 9861 (BOL, KIR, PRE), 9915 (BOL), 15124 (BOL); *Galpin* 12738 (PRE); Observation Peak *Esterhuysen* 8630 (BOL); Du Toits Peak *Esterhuysen* 8606 (BOL). PAARL: Pic Blanc *Esterhuysen* 1659 (BOL); Wellington Sneeuwkop Up. *Esterhuysen* 12417 (BOL); Lr. *Esterhuysen* 8655 (BOL); Haalhoek Spitzkop *Esterhuysen* 15168 (BOL); Berg River Hoek *Drège* 1949 (BM, CGE, G, K, OXF, P, S), 1949a (G, K, P), 1949b (CGE, G, OXF, P, S); Wemmershoek *Andreae* 797 (PRE); Banhoek Peak *Esterhuysen* 14362 (BOL, PRE). STELLENBOSCH: Stellenbosch *Garside* 447 (K); *Penther* 2750 (BM); Jonkershoek Twins *Esterhuysen* 18483 (BOL); Steenbras River Mouth *Adamson* 4030, 4033; Hottentots Holland *Ecklon & Zeyher* 2395 (CTM); Banhoek *Esterhuysen* 19897 (BOL). CALEDON: Villiersdorp *Salter* 2119 (BM, BOL); Viljoens Pass *Gillett* 689 (BOL); *Salter* 2023 (K), 2028 (BM, K); Houwhoek *Schlechter* 7350 (BM, G, K, P, PRE, CTM); Genadendal *Bolus* 632 (BM, CTM, G, GRA, K, P); Mossel River *L. Guthrie* (BOL); Hermanus *Martin* 298 (KIR). BREDASDORP: Napier *Barker* 7253 (KIR). LADISMITH: Roodeberg *Lewis* (CTM).

Specimens (*Barker* 7192 (KIR)) from Shaws Mountain, Caledon, are like this species but have a much branched inflorescence and flowers with the corolla blue-purple externally. They may represent the hybrid *P. brevilobus × fruticosus*.

6. **P. decurrens** Adamson sp. nov.

Caules decumbentes e basi solum ramosi. Folia numerosa secunda vel squarrosa saepissime falcata lanceolata acuta dentata decurrentia. Inflorescentia aphylla tenuis ramosa. Bracteae minutae. Flores pedicellati. Calycis lobi acuti corolla multo breviores. Corolla campanulata, tubo lobis subaequilongo vel longiore.

Low-growing with several unbranched decumbent stems from a woody base. Leaves crowded, lanceolate, acute, 0·5—1 cm. long, 2—3 mm. wide, squarrose or secund, most often falcate, concave above, coarsely ciliate at the base, with 1 or 2 teeth on each margin, the base decurrent and ciliate. Inflorescence glabrous, leafless, 5—10 cm. long, branched. Flowers pedicellate. Bracts very small, ciliate at the base. Calyx lobes 2—3 rarely 4 mm. long, glabrous, less than half as long as the corolla. Corolla campanulate, 1—1·3 cm. long, white or tinged with blue, concolorous, the tube as long as or longer than the lobes. Fruit slender, glabrous, about 1—1·5 cm. long

Endemic to the Cedarberg range, usually among rocks at 3,000 ft. or higher.

The type is *Esterhuysen* 2787 in herb Bolus.

A distinctive species, in flowers like *P. brevilobus* but quite different in habit and leaf.

CLANWILLIAM: Middelberg Plateau *Esterhuysen* 2787 (BOL); Sneeuwberg *Esterhuysen* 13820 (BOL p.pte. K, KIR, PRE), 13823 (KIR).

7. **P. alpinus** (Bond) Adamson comb, nov.

Roella alpina Bond J. S. Af. Bot. 6. 61. 1940.

Stems woody at the base, much branched, the branches short and crowded and forming close or loose mats or cushions, or in shelter more elongated and erect. Leaves crowded at the tips of the branches, pale green, linear, 0·5—1·5 cm. long, rather rigid, often secund, concave above, coarsely ciliate near the base, the tip often incurved. Flowers sessile or on a brown glabrous peduncle up to 10 cm. long either unbranched or with few branches. Flowers few, 1—5. Bracts like the leaves but much smaller. Calyx lobes glabrous, flat, 2—3 mm. long, acute or subacute, distinctly connate at the base, much shorter than the corolla tube. Corolla deep blue, often purplish on fading, funnel-shaped, 0·5—1 cm. long, the acute lobes about as long as the tube. Ovary glabrous, purple-brown, 2—6 mm. long. Fruit 0·5—1 cm. long, narrowed to the base.

On the highest parts of the mountains in the south-west.

The type is *Compton* 8456 in herb Kirstenbosch.

A very distinctive species, somewhat variable in habit. The type specimen which was collected on an exposed summit, has very short branches and sessile flowers. Others which agree in all features of leaf and flower, range from mat plants with a short peduncle to erect ones with an elongated branched inflorescence. The differences are correlated with habitat conditions. Though originally described under *Roella* the fruit has longitudinal dehiscence.

CERES: Mts. above Laken Vlei *E. P. Phillips* 1979 (CTM). WORCESTER: Matroosberg *A. Bolus* 4416 (BOL); *Marloth* 2368 (PRE); *Stokoe* (CTM); Roodeberg *Compton* 8456 (BOL, KIR); *Esterhuysen* 1578 (BOL); Waaihoek Peak *Esterhuysen* 9893 (BOL, PRE); Slanghoek Peak *Esterhuysen* 1733 (BOL). TULBAGH: Winterhoek *Marloth* 1648 (BOL); *Esterhuysen* 19768 (BOL); Sneeuwgat *Esterhuysen* 19831 (BOL). CALEDON: Landtrostkop *Thorne* (CTM).

8. **P. crispus** L'Hérit. Sert. Ang. 2. 1788.

Campanula plicata Pers. Syn. 1. 193. 1805.

A stout annual up to 50 cm. high with an almost woody stem, the lower branches ascending, the upper divaricate. Stems thinly hairy. Leaves rather widely scattered, 1—4 cm. long, 2—4 mm. wide, flat, undulate, spreading or ascending, coarsely but usually thinly hairy. Leaves often deciduous at flowering time. Inflorescence glabrous or hairy, up to 25 cm. long, with divaricate branches and solitary terminal flowers. Bracts like the leaves but much smaller, often caducous. Calyx and ovary hairy or glabrous. Calyx lobes linear, 1·3—1·7 cm. long. Corolla pale blue or violet, sometimes pinkish, cup-shaped, 2—3 cm. long, the tube about a quarter the length of the acute lobes. Fruit 4—6 cm. long, glabrous or hairy.

Dry slopes or flats, mostly on sand, in the western and northern districts. Extends into the margins of the karroo.

The type is *Masson* in herb Brit. Mus.

Variable in size and the degree of hairiness. Easily recognized by the flat undulate leaves, divaricate inflorescence, large flowers, and the corolla divided to near the base.

Van Rhynsdorp: Nardouw Kloof *Pearson* 5332 (K); Van Rhynsdorp *Esterhuysen* 1422 (PRE). Clanwilliam: Clanwilliam *Galpin* 10719 (PRE); Alpha *Esterhuysen* 7148 (BOL, PRE); Nieuwoudt Pass *Bond* 1325 (KIR); Klaver *Marloth* 12550 (PRE); Olifants River *Esterhuysen* 17849 (BOL), 1421 (BOL, KIR, PRE); *Mathews* (BOL, K); *Leipoldt* (BOL). Victoria West: Brakfontein *Thode* A2164 (K, PRE). Piketberg: Greys Pass *Compton* 18836 (KIR); *Leighton* 2378 (BOL, K, PRE); *Pillans* 2378 (K); Piketberg *Compton* 3632 (BOL); Zandberg *Pillans* 8588 (BOL); Versvelds Pass *Pillans* 7129 (BOL). Malmesbury: Riebeck Kasteel *Salter* 1794 (K). Ceres: Rosendalfontein *Pillans* 9586 (BOL). Tulbagh: Winterhoek *Ecklon & Zeyher* (CTM), 2397 (G S); Waterfall *Ecklon & Zeyher* 2397 (CTM, OXF). Worcester: Worcester *Ecklon & Zeyher* 9 (S), 2397 (CTM, S). Caledon: Caledon *Esterhuysen* 4408 (BOL); Sondereinde River *Zeyher* (S). Bathurst: Glenfilling *Drège* 6330 (S), 6330b (BM, CGE, G, K, OXF, P), 6330c (P). Without Locality: *Masson* (BM); *Verreaux* (P).

9. **P. Hildebrandtii** Vatke Linnaea 38 (N.F.4) 701. 1874.

Allied to *P. crispus* but usually glabrous and much more branched, with ascending branches. Leaves deciduous, widely scattered, flat, not undulate, the margins revolute, thickened and with a few teeth. Inflorescence with many branches, not divaricate. Bracts very narrow. Calyx lobes linear, 1—1·5 cm. long, connate at the base and slightly projecting. Corolla pale violet or blue, 2·5—3 m. long, widely campanulate, the tube almost as long as the lobes. Fruit up to 8 cm. long, 3—4 mm. diam. gradually narrowed to the ends.

Dry open places in the northern regions. Sporadic in occurrence and apparently rare.

The type is *Meyer* 1869 in herb Vienna.

Very variable in size. Distinguished by the leaves, large flowers with the corolla divided half way, and the large fruits.

CALVINIA: Hantamsberg *Meyer* 1869. VAN RHYNSDORP: Van Rhyns Pass *Esterhuysen* 1422 (BOL). S.W.A: Aus *Dinter* 3595 (BM, BOL, PRE); Kurumanas *Dinter* 8296 (K); Lichtenstein *Dinter* 4478 (PRE, S).

Specimens in herb Kew have been labelled "*P. ausensis*".

Series 2. STRICTI.

Perennes lignosae. Folia alterna. Flores sessiles saepe subspicati vel subcapitati. Bracteae foliis latiores, integrae vel dentatae. Corolla plus minusve campanulata, alba vel purpurascens raro coerulea.

Diffuse sprawling or less often erect woody perennials. Leaves alternate. Flowers sessile, most often aggregated at the branch tips or in small heads. Bracts broader and generally larger than the leaves, entire or toothed. Corolla usually small, white, pink or violet, rarely blue.

KEY TO THE SPECIES.

1. Bracts entire: leaves entire.
   2. Sparsely or not branched: bracts firm: corolla cup-shaped, over 1 cm. long: ovary very narrow, stalk-like .. .. 10. *campanuloides*
   2. Much branched: bracts thin: corolla campanlate, less than 1 cm. long: ovary broad, prismatic .. .. 11. *Schlechteri*

1. Bracts toothed.
   3. Leaves entire: bracts with 1 lateral tooth on each side: corolla cup-shaped .. .. .. 10. *campanuloides* var. *dentatus*
   3. Leaves toothed: bracts with two or more lateral teeth on each side: corolla campanulate.
      4. Slender, sprawling, much branched: leaves flat: bracts broad with pinnate teeth: corolla less than 1 cm. long.
         5. Flowers in heads: bracts hispid: calyx hairy .. .. 13. *hispidus*
         5. Flowers not in heads: bracts ciliate: calyx glabrous .. .. 12. *Rogersii*

4. Usually stout, erect: leaves revolute: bracts deeply toothed.
6. Bracts hairy, palmately lobed, the central lobe not longer than the others: calyx hairy: corolla less than 1 cm. long 17. *spinosus*
6. Bracts glabrous, pinnately lobed, the central lobe longer than the others: corolla over 1 cm. long.
7. Usually unbranched: leaves slightly revolute: bracts with the central lobe much longer than the lateral. . 15. *virgatus*
7. Branched: leaves strongly revolute: bracts with the terminal lobe slightly longer than the lateral.
8. Diffuse: flowers not in heads: bracts with the lateral lobes forwardly directed: corolla campanulate, the lobes as long as the tube .. .. 14. *Candolleanus*
8. Erect with short branches: flowers in heads: lobes of the bracts spreading: corolla tubular-campanulate, the lobes shorter than the tube .. .. 16. *cliffortioides*

10. **P. campanuloides** (L.f.) Sond. Fl. Cap. 3. 589. 1865.

Polemonium campanuloides L.f. Supp. Pl. 189. 1781. *Retzia campanuloides* Spreng. Syst. 1. 589. 1825. *P. strictus* A.DC. Monog. Camp. 169. 1830. *P. linariaefolius* A.DC. lc. 169. *P. Ecklonii* A.DC. l.c. 168.

Usually glabrous. Stems not or little branched, up to 75 cm. high, erect, ascending or sprawling, woody at the base. Leaves firm, linear or linear-lanceolate, 1—2 cm. long, 1—2·5 mm. wide, ascending, flat or revolute, entire, usually ciliate, crowded or distant. Inflorescence sometimes branched, the flowers usually crowded near the top more distant below. Bracts 0·5—1 cm. long, entire, more or less boat-shaped, ciliate at least at the base, from as long as to half as long as the ovary: bracteoles similar but smaller, ciliate all along. Flowers sessile but the ovary very narrow and stalk-like. Calyx lobes linear, 0·7—1 cm. long, often involute. Corolla white or tinged with pink or violet, cup- or saucer-shaped, 1—2 cm. long, as long as or longer than the calyx lobes, divided more than half way. Fruit about 2 cm. long.

Dry mountain slopes along the south coast. Rather common.

The type is in herb Thunberg, Uppsala.

Flowers transient, fading rapidly. Variable in size and habit. DeCandolle's two species, *P. strictus* and *P. linariaefolius*, are not separable and are both certainly conspecific with Thunberg's type. *P. Ecklonii* only differs in being more slender, with shorter leaves and narrower bracts. It is a form found in the Caledon district but is connected by all stages of intermediate. *Marloth* 8355 (PRE) from Langeberg, Robertson, is an extreme form.

Worcester: Worcester *Andreae* 363 (PRE). Tulbagh: Waterfall *Pappe* (CTM, K, PRE). Caledon: Bosjesveld Mts. *Stokoe* 7545 (BOL), sn (CTM, PRE); Caledon *Purcell* (CTM); *Verreaux* (G); Swartberg *Ecklon & Zeyher* 2396 (CTM); Genadendal *Bolus* 9906 (BOL); *Burchell* 7613, 8630 (K); *Ecklon & Zeyher* 81 (S), 2396 (S); *Gillett* 844 (BOL); *Schlechter* 10284 (BM, BOL, G, GRA, K, P, PRE); Greyton *Esterhuysen* 5074 (BOL, PRE); Sondereinde Mts. *Barker* 1031 (KIR); *Burchell* 7551, 7586 (K). Robertson: Langeberg *Galpin* 9906 (K, PRE); *Marloth* 8355 (PRE); Sondereinde Mts. *Adamson* 4431, 4448. Bredasdorp: Bontebok Park *Compton* 21925 (KIR); *Johnson* 4 (KIR); The Poort *L. Bolus* (BOL, K); *Barker* 5262 (KIR); Rietfontein *Schlechter* 10595 (BM, BOL, G, GRA, K, P, S); Jantjesbosch *C. A. Smith* 4277 (PRE). Swellendam: Potteberg *Adamson* 3908, 4316, 4318. Riversdale: Albertinia *Muir* 1283, 1957 (J, PRE); *Esterhuysen* 19513 (BOL). Mossel Bay: Langeberg *Moran* (CTM); Mossel Bay *Salter* 371/17 (BM); Robinson Pass *Salter* 376/41 (BM). George: George *Guthrie* 4345 (KIR); *Paterson* 1212 (GRA); *Schlechter* 2400 (GRA); Outeniqua Mts. *Bolus* (BOL); *Bowie* (BM); *Schlechter* 2400 (BOL, K). Knysna: Plettenburg Bay *Bowie* (BM); Zitzikama *Drège* 6330 (S), 6330c (G, K, OXF). Humansdorp: Eerste River *Fourcade* 1179 (BOL, GRA, K); Slang River *Fourcade* 1873 (BOL); *Sparrman* 11 (S); Jeffreys Bay *Hutchinson* 1462 (K); Krakakama *Delessert* (G); *Burchell* 4529 (K); Maitland River *Burchell* 4598 (K); Gamtoos River *Bolus* 3051 (BOL); *Story* 2403 (GRA). Uitenhage: Winterhoek *Ecklon & Zeyher* 2399 (CTM); *Zeyher* 101 (CTM); Witteklip *MacOwan* 1083 (GRA); Van Stadens River *MacOwan* 1083 (BM, P, PRE); Uitenhage *Ecklon* (S); *Ecklon & Zeyher* (S), 2398 (CGE, GRA, OXF, S); *Penther* 2757 (S); *Zeyher* 101 (BM, K); Swartkops River *Ecklon & Zeyher* 101 (S), 2398 (BOL, G, P, S); *Zeyher* 2398 (S), 3148 (CTM, K, P, PRE). Port Elizabeth: Port Elizabeth *de Castelnau* 334 (P); *Forbes* (K); *Prior* (K); *Rogers* 27638 (K); "*W.J.*" (CGE); Baakens River *Galpin* 9920 (K, PRE); Sea View *F. R. Long* 286 (K); Parsons Vlei *F. R. Long* 535 (K), 541 (K, PRE); Redhouse *Paterson* 485 (GRA, K); Thescomb *Paterson* 485 (BOL); Thornhill *Story* 2403 (PRE). Alexandria: Alexandria *Galpin* sn (BOL), 10836 (K); *Burtt-Davy* 12111 (PRE). Albany:

Sandflats *Rogers* 193 (GRA), 3259 (GRA); Grahamstown *Hafstrom & Acock* 1502 (PRE); *Prior* (K); *Wall* (S); Bushmans River *Compton* 19350 (KIR); *Leighton* 2612 (BOL, PRE); Seven Fountains *Leighton* 2833 (BOL); Hofmanns Bush *Britten* (GRA); Assegai River *Compton* 19057 (KIR). BATHURST: Port Alfred *Barker* 2177 (KIR); Kowie *Ryder* 24 (K); *Tyson* (GRA, PRE, S.); *MacOwan* 922 (GRA). SOMERSET: Somerset East *Bowker* (K). EAST LONDON: Gonubi Springs *Compton* 13141 (KIR); *Rattray* 1382 (BOL); Kidds Beach *Barker* 1288 (KIR); "Caffirland" *Gill* (K). WITHOUT LOCALITY: *Burman* (G); *Ecklon & Zeyher* (CGE); "*V.H.*" (S); "*Hort. Kew*" (CGE, K); *Maire* (P); *Pappe* (K); *Verreaux* (G, P); *Zeyher* 203 (P), sn (K).

A specimen from Naukloof Mts., S.W.A. (*Pearson* 9060 (K)) may belong to this species. It differs in having a stout woody base with many slender branches, very small leaves, and almost flat bracts. The material is insufficient for complete determination.

Var. **dentatus** Adamson var. nov.

A typo differt caulibus robustioribus, ramosis; foliis revolutis; bracteis paucidentatis ovario brevioribus.

More woody and more branched than the common form. Leaves revolute. Bracts broader, less ciliate, and usually with a single lateral tooth on each side. Ovary longer than the bracts.

Rare in the Caledon district.

The type is *Gillett* 726 in herb Bolus.

CALEDON: Elandskloof Pass *Gillett* 726 (BOL); Genadendal *Schlechter* 10284 (K). WITHOUT LOCALITY: "*Hort. Kew*" (K).

11. **P. Schlechteri** Adamson sp. nov.

Suffrutex ramosissima ramis ascendentibus. Folia glabra lineari-lanceolata integra marginibus subrevolutis. Flores parvi ad apicem ramorum aggregati. Bracteae integrae tenerae subciliatae ovario aequilongae. Calycis lobi plani, corolla multo breviores. Corolla campanulata, tubo lobis aequilongo. Fructus brevis late cylindricus bracteis paulo longior.

A small erect much branched shrublet up to 40 cm. high, the branches ascending. Stems glabrescent above, hairy below. Leaves scattered, linear-lanceolate, 0·6—1·5 cm. long, 2—3 mm. wide, entire, glabrous, rather thin, slightly revolute when old. Flowers crowded at the tips of the branches, not in heads. Bracts entire, rather thin, 5—6 mm. long, 3—4 mm. wide, acute, very shortly ciliate, as long as the ovary. Calyx lobes flat, acute, 3—4 mm. long, 1·5—2 mm. wide, glabrous, much shorter than the corolla. Corolla campanulate, 0·5—0·8 cm. long, white or tinged with blue or mauve, the lobes about as long as the tube. Ovary glabrous. Fruit cylindrical-prismatic, 7—8 mm. long, 2 mm. diam., slightly longer than the bracts.

Sandy soils in the extreme south. Apparently rare.

The type is *Schlechter* 7670 in herb Bolus.

A distinctive species that has been confused with *P. campanuloides* but quite different in habit, calyx, corolla and fruit. Fourcade (Trans. R. Soc. S. Af. 21. 83. 1932) quotes the plant under *P. Rogersii* but it differs markedly in habit, leaf-shape, bracts and fruit.

BREDASDORP: Elim *Schlechter* 7670 (BM, BOL, G, K). CALEDON: Babylons Tower *Esterhuysen* 4993 (BOL, GRA, KIR). PAARL: Wemmershoek *Andreae* 810 (PRE).

12. **P. Rogersii** Fourcade Trans. Roy. Soc. S. Afr. 21. 83. 1932.

A slender diffuse sprawling shrublet. Stems woody, shortly hairy, with lax branching. Leaves scattered, often distant, rather soft, linear-lanceolate or linear-oblong, 0·5—2 cm. long, 2—4 mm. wide, flat or very slightly revolute, the margins with distant acute teeth, ciliate at the base, usually with a few stout hairs on the midrib below. Axillary tufts of small leaves sometimes present. Flowers aggregated at the tops of the branches but scarcely in heads. Bracts broad at the base, glabrous, ciliate, 5—7 mm. long, the margins with deep narrow spreading pinnate lobes, the terminal point longer than the lateral. Ovary shorter than the bracts, 5—6 mm. long. Calyx lobes flat, acute, 3 mm. long. Corolla white, 0·5—0·8 cm. long, rather narrowly campanulate, the lobes less than half as long as the tube. Fruit brown, 0·7—1 cm. long, fusiform and distinctly narrowed at the ends.

Bushy mountain slopes in the central south coast mountains.

The type is *Fourcade* 3254 in herb Bolus.

Readily distinguished by the habit and bracts. At the fruiting stage the flowers may appear as if in heads.

GEORGE: Montagu Pass *Esterhuysen* 10855 (BOL); *Fourcade* 3254 (BOL, K), 5535 (KIR); George *Bolus* 8662 (K), 8663 (BOL, K); *Rogers* 16199 (J, K), sn (BOL); *L. E. Taylor* 1634 (PRE); *Paterson* 1253 (GRA); Postberg *Burchell* 5960 (K): Cradockberg *Compton* 14388, 14391 (KIR).

13. **P. hispidus** Adamson sp. nov.

P. Rogersii affinis sed differt caulibus et foliis et floribus hispidis; foliis latioribus dentatis: floribus in capitulis terminalibus aggregatis; et corolla minore.

A sprawling hispid shrublet with woody branching stems up to 60 cm. long. Leaves scattered, dark green, ovate, acute, 4—7 mm. long, 2—

4 mm. wide, more or less revolute, densely hispid below thinly above, the margins with 2—3 distant acute teeth. Flowers 3—5 in terminal heads 1 cm. long and 0·8 cm. diam. Bracts coarsely hispid, 7—9 mm. long, deeply pinnately toothed or lobed, the lateral teeth spreading, the terminal not or very slightly longer. Calyx and ovary hispid. Calyx lobes flat, lanceolate, acuminate, 4 mm. long. Corolla white, 5—8 mm. long, narrowly campanulate or tubular, the lobes as long as the tube. Ovary shorter than the bracts. Fruit fusiform-prismatic, sulcate, 0·5 cm. long.

Rocks or stony slopes on the Outeniqua and adjacent mountains at 2,000—3,000 ft.

The type is *Adamson* 4351 in herb Bolus.

A distinctive species allied to but quite different from *P. Rogersii.*

Mossel Bay: Robinson Pass *Adamson* 4349, 4351; *Laughton* 132 (BOL); *Salter* 376/42 (BM), 3252 (BM, BOL); Cloetes Pass *Zinn* (CTM).

Specimens in herb BM have been labelled "*P. fasciculatus*".

14. **P. Candolleanus** Cham. Linnaea 8. 197. 1833.

An erect branching shrublet up to 50 cm. high. Stems woody, very shortly hairy, the branches ascending. Leaves usually crowded, spreading, rigid, linear-lanceolate, acute, 1—2 cm. long, 2—3 mm. wide, revolute, entire or commonly with distant teeth. Flowers loosely spicate, not in heads, the flower region not over 5 cm. long. Bracts glabrous, broad and clasping at the base, 7—9 mm. long, with a long acuminate point and 2—3 narrow forwardly directed teeth on each side: bracteoles pinnately lobed. Calyx lobes 3—4 mm. long, glabrous, acute. Corolla widely campanulate, 1—1·25 cm. long, pale violet or white, the lobes as long as the tube. Ovary shortly hairy, shorter than the bracts. Fruit about 1 cm. long.

Lower slopes and flats in the central south coast region.

The type is *Mundt* in herb Berlin.

Distinguished by the rigid entire leaves, spicate flowers, and the toothed bracts. The flowers are short-lived.

Swellendam: Swellendam *Ecklon & Zeyher* 2401 (CTM, S). Oudtshoorn: Meirings Poort *Thorne* (CTM). Riversdale: Albertinia *Muir* 1957 (BOL), sn (BOL). Mossel Bay: Reutersbosch *Mundt* (K). George: Gt. Brak River *Fourcade* 3852 (BOL, K); Wit Els River *Fourcade* 6371 (BOL).

15. **P. virgatus** Fourcade Trans. Roy. Soc. S. Af. 21. 83. 1932.

An erect virgate usually glabrous shrublet. Stems solitary, rather stout, up to 60 cm. high. Leaves ascending, often appressed, scattered above, more crowded below: upper leaves flat, the edges slightly revolute, 2—3 cm. long, 3—4 mm. wide, acute, with 1—2 pairs of sharp lateral teeth: lower leaves smaller. Inflorescence 4—10 cm. long, the flowers mostly crowded near the tip but some more distant below. Bracts leaf-like but broader at the base, 7—9 mm. wide, the tip acuminate up to 1 cm. long, the base with sharp lateral teeth 2—3 mm. long. Bracts as long as or longer than the ovary. Calyx lobes glabrous, lanceolate, acute, up to 1 cm. long. Corolla white or tinged with mauve, widely campanulate, slightly longer than the calyx lobes, divided about half way. Ovary 1—1·5 cm. long.

Apparently rare on mountain slopes in the Long Kloof area.

The type is *Fourcade* 4528 in herb Bolus.

In habit like a stout *P. campanuloides*. Closely related to *P. Candolleanus* and distinguished by the habit, the flat slightly revolute leaves and the bracts with a long terminal point.

George: Montagu Pass *Compton* 13167 (KIR). Uniondale: Avontuur *Fourcade* 4528 (BOL); De Hoek *Esterhuysen* 13625 (BOL, PRE); Mannetjeberg *Esterhuysen* 18473 (BOL). Oudtshoorn: Kamanassie *Stokoe* (CTM).

16. **P. cliffortioides** Adamson sp. nov.

P. Candolleano affinis sed differt caulibus lignosis erectis ramis perbrevibus: foliis revolutis dentatis pungentibus; floribus dense aggregatis spicato-capitatis; bracteis palmato-pinnatilobatis, lobo terminale longo pungente; corolla tubuloso-campanulata calyce plus duplo longiore.

A stout erect shrub, 20 cm.—1 m. high, with many short branches. Stems woody, reddish brown, very shortly hairy, up to 8 mm. diam. Leaves glabrous, scattered but crowded on the branches, 1—1·5 cm. long, linear-lanceolate, revolute, pungent-acute, remotely toothed. Flowers in terminal heads. Bracts broad-based, 1—1·5 cm. long, deeply pinnately lobed, the terminal lobe long, pungent, the lateral lobes long near the top shorter at the base, the edges of the lobes revolute. The central lobe of the bract often has 1 or 2 small teeth at its base. Ovary shorter than the bracts. Calyx lobes glabrous, flat, 4—7 mm. long. Corolla tubular-campanulate, 1—2 cm. long, pale blue, the lobes shorter than the tube. Fruit about 1 cm. long, 3 mm. diam.

Very local on mountain slopes about the Gouritz River.

The type is *Adamson* 4336 in herb Bolus.

Allied to *P. Candolleanus* but differing in habit, densely aggregated flower heads, the larger and more toothed bracts, and the tubular corolla with short lobes. Specimens in collections have been labelled *P. strictus* var. *robustus*.

RIVERSDALE: Riversdale *Ferguson* (BOL). MOSSEL BAY: Cloetes Pass *Adamson* 4336, 4342; *Stokoe* (CTM); *Zinn* (CTM); Melkhoutessenbosch *Muir* 1371 (BOL, PRE).

17. **P. spinosus** Adamson sp. nov.

Suffrutex hirsuta ramosa. Folia ovata dentata pungentia. Flores bracteis circumdati. Bracteae hirsutae, foliis latiores, profunde palmatolobatae, lobis pungentibus, acumine lobis vix longiore. Calycis lobi hirsuti corolla breviores. Corolla alba tubulosa, tubo lobis duplo longiore. Ovarium hirsutum sulcatum bracteis brevius.

A stout erect woody plant covered all over with short and long white hairs. Stems up to 1 m. high, with many ascending branches. Leaves ovate, 0·5—1 cm. long, 3—5 mm. wide, flat or revolute when dry, pungent-acute, remotely toothed, subglabrous above, densely hairy below: older leaves reflexed. Flowers terminal, usually solitary, surrounded by about 5 bracts, the innermost pair smaller. Bracts hairy, pungent, 6—8 mm. long, 5—6 mm. wide, palmately lobed with 5—7 almost equal lobes all forwardly directed. Calyx lobes hairy, lanceolate, 4—5 mm. long, distinctly connate at the base. Corolla white, tubular, 0·8—1 cm. long, the lobes much shorter than the tube. Ovary obtusely sulcate, shorter than the bracts. Fruit sulcate, hairy, about 0·8 cm. long.

A local endemic on rocks at the summits of hills in the Potteberg.

The type is *Adamson* 3906 in herb Bolus.

SWELLENDAM: Potteberg *Adamson* 3899, 3900, 3906; *Barker* 5284 (KIR).

Series 3. NITIDI.

Perennes raro annuae, herbaceae vel sublignosae seapissime prostratae. Flores parvi solitarii axillares, bracteis foliis similibus sed saepe minoribus. Filamenta staminum basi paulo vel haud dilatata.

Perennials usually herbaceous, often prostrate. Flowers axillary, most often solitary, the bracts like the leaves but smaller. Flowers small, sessile or nearly so. Stamens with the base of the filaments ciliate but little or not dilated.

In several species the internodes in the flowering region may become much elongated giving the appearance of pedunculate flowers.

KEY TO THE SPECIES.

1. Leaves linear, either filiform or nearly so: flowers small, white: herbs.
  2. Leaves alternate: flowers sessile or in small raceme-like groups .. .. 18. *sessilis*

2. Leaves opposite: flowers in a long leafless inflorescence with divaricate branches .. .. 20. *tenellus*

1. Leaves flat, linear-lanceolate to ovate: flowers mostly solitary.

3. Leaves linear-lanceolate, less than 2 mm. wide: flowers axillary: stems woody .. .. .. 19. *tenerrimus*

3. Leaves lanceolate, ovate or oblong, at least 2 mm. wide.

4. Leaves alternate.

5. Erect woody plants with divaricate spine-tipped branches: flowers sessile .. .. 25. *lycioides*

5. Herbs, woody at the base only: branches not divaricate nor spinous.

6. Erect annual: leaves over 2 cm. long: flowers pedicellate .. .. 26. *rhodesicus*

6. Perennials, prostrate or sprawling: leaves less than 1 cm. long: flowers sessile or nearly so.

7. Leaves glabrous, usually toothed: bracts leaf-like .. .. 21. *nitidus*

7. Leaves hairy: bracts deeply toothed.

8. Leaves ovate, cordate, toothed: calyx lobes glabrous .. .. 22. *cordifolius*

8. Leaves lanceolate, not cordate, slightly revolute: calyx lobes hairy 21. *lasiophyllus*

4. Leaves opposite at least in the lower parts, usually hairy .. .. 23. *debilis*

18. **P. sessilis** Eckl. ex A.DC Monog. Camp. 171. 1830.

P. acerosus Schinz Bull. Herb. Boiss. 2. 217. 1894. *Wahlenbergia filicaulis* Good J. Bot. 62. 48. 1924.

Stems wiry, usually procumbent, many from the root, up to 60 cm. long, much branched, very slender, reddish or brown. Young stems minutely hairy but soon glabrescent. Leaves alternate, linear, concave above and often involutely rolled, 1—2 cm. long, straight or curved, crowded or scattered, often secund, glabrous except for a few stout cilia at the base. Flowers small, solitary or in groups of 2 or 3, the lower sessile the upper pedicellate and often on almost leafless branches: pedicels 0·3—1·5 cm. long. Calyx glabrous, the lobes less than 2 mm. long. Corolla white, often yellowish or pale blue on fading, narrowly campanulate, 3—5 mm. long, the lobes shorter than the tube. Ovary fusiform, distinctly narrowed at the ends. Fruit 4—6 mm. long.

Humus soils from sea level to mountain tops in the extreme south-west.

The type is *Ecklon* (herb Dunant) in herb DC. Geneva.

Apparently annual. Variable in size, habit, and leaf arrangement. *P. acerosus* does not seem to be more than a form from exposed sites. Insect galls are common and cause a considerable swelling of either the flower bud or the ovary: *Wahlenbergia filicaulis* was based upon such a galled plant.

CAPE: Cape Flats *Bolus* 3289 (GRA, K); *Zeyher* 278 (S); Doornhoogte *Zeyher* 750 (S), 1080 (BOL, CTM, CGE, G, K, P, PRE, S); Cape Town *Marloth* 9483 (PRE); Table Mt. *Adamson* 1632; *Bolus* 7087 (BOL); *Compton* 8289 (KIR), 12540 (KIR), 16966 (KIR); *Ecklon* (G, S), 152 (S); *Esterhuysen* 7843 (BOL), 11407 (BOL), 11495 (KIR, PRE), 12540 (BOL, PRE, KIR); *Harvey* (BM); *Stokoe* (CTM); Orange Kloof *Wolley-Dod* 2128 (BM, K); Groot Kop *Esterhuysen* 10033 (BOL); Rondebosch *Bolus* 3289 (BOL, PRE); Kenilworth *Flanagan* 2454 (P, PRE); *O. Kuntze* (K); *Schlechter* 224 (BM, CGE); *Wolley-Dod* 2611 (BOL); Wynberg *Schlechter* 23 (BM, CGE, GRA, P, PRE); *Wallich* 411 (BM), sn (BM); Bergvliet *Marloth* 8408 (PRE); Muizenberg *Bolus* 3289 (BM, BOL, CTM); *Bond* 1557 (KIR); *Salter* 292/23 (BM); Steenberg *Wolley-Dod* 276 (BM, BOL, K); Simonstown *Milne* 169 (K); Klaver Valley *Adamson* 819, 821 (PRE), 822; *Moss* 7503 (BM); *Wolley-Dod* 297 (BOL, K); Schusterskraal *Barker* 3995 (BOL, KIR); Boyskraal *Compton* 16665 (KIR); Bonteberg *Adamson* 1646; *Salter* 4284 (BM, BOL, K, PRE); Theefontein *Barker* 3959 (KIR); Smitswinkel *Compton* 16939 (KIR); *Galpin* 12733 (K, PRE); *Leighton* 924 (BOL, PRE); Patrys Vlei *Compton* 15498 (KIR); Dassiefontein *Adamson* 1648; Paulsberg *Adamson* 2460, 2466; Smiths Farm *Acock* 3820 (S); Cape Point *Lewis* (CTM). STELLENBOSCH: Flats *Burchell* 964 (K). CALEDON: Palmiet River *Adamson* 4183; *Esterhuysen* 12584 (BOL, KIR, PRE); *Stokoe* (CTM); Kleinmond *Wall* 520/33 (S); Onrust *Schlechter* 10385 (BOL, G, GRA, K, P, S, CTM); Hermanus *Galpin* 12849 (K, PRE); *Gillett* 630 (BOL, K). SWELLENDAM: Mts. *Burchell* 7367 (K). WITHOUT LOCALITY: *Ecklon & Zeyher* 17 (P, S); *Harvey* 219 (K), 247 (K), 267 (BM); *Masson* (BM); *Wallich* (CGE, G); *Sieber* 19 (P); *Zeyher* (S).

Var. **macrocarpus** Adamson var. nov.

A typo differt caulibus suberectis; floribus majoribus pedicellatis paniculatis; fructibus duplo longioribus.

Larger than the usual form and almost or quite erect. Flowers in a terminal almost leafless panicle with minute bracts. Corolla 0·5—0·8 cm. long. Fruit 1—1·5 cm. long, distinctly pedicellate.

Restricted to sites near the coast in the Caledon Division.

The type is *Esterhuysen* 13716 in herb Bolus.

Caledon: Rooiels *Esterhuysen* 13716 (BOL, KIR); Steenbras Mouth *Salter* 4219 (BOL), 4257 (BM, BOL); *Galpin* 12418 (K), 12718 (PRE).

19. **P. tenerrimus** Buek in Eckl. & Zeyher Enum. 384. 1837.

P. Burchellii Vatke Linnaea 38. (N.F.4.) 701. 1874.

Slender, erect or sprawling. Stems woody at the base, with few or many ascending branches, the younger red or brown, minutely hairy. Leaves alternate, scattered, often closer towards the base, linear-lanceolate, 0·5—1·3 cm. long, 1—3 mm. wide, flat or slightly revolute, glabrous or with cilia at the base, entire or rarely with a few lateral teeth, the midrib very slightly projecting below. Flowers axillary, raceme-like, solitary or less often in groups of 2 or 3, sessile or with pedicels up to 1 cm. long. Bracts like the leaves but smaller, more ciliate and occasionally toothed: bracteoles 0·3—0·5 cm. long, just below the ovary. Calyx lobes glabrous, lanceolate, acute, 2—3 mm. long. Corolla 0·6—1 cm. long, pinkish or white, campanulate, the lobes as long as or slightly longer than the tube. Ovary 0·3—0·6 cm. long. Fruit narrowly fusiform, often curved, 0·6—1 cm. long, about 2 mm. diam.

Widely spread but not common on the mountains along the south-west and south coast, extending eastwards as far as Riversdale.

The type is *Ecklon & Zeyher* 2402 in herb Berlin.

Variable in size and habit: in shelter erect and little branched, in exposed places woody, decumbent and much branched. There seem no constant features by which *P. Burchellii* (type *Burchell* 7665 (K)) can be separated even as a variety.

Paarl: Wemmershoek *Marloth* (PRE). Stellenbosch: Jonkershoek Twins *Esterhuysen* 11485 (BOL). Caledon: Paardeberg *Adamson* 4190, 4204; *Stokoe* 9110 (BOL); Onrust *Esterhuysen* 4927 (BOL); Hermanus *Gillett* 663 (BOL, K); Shaws Mt. *Adamson* 4446; *Hafstrom & Acock* 2009 (PRE); *Salter* 5155 (BM, BOL, K); Babylons Tower *Esterhuysen* 4992 (BOL, KIR); *Thorne* (CTM); Swartberg *A. Bolus* (BOL); *Ecklon & Zeyher* 2402 (CTM); *Schlechter* 9768 (BM, BOL, G, GRA, K, P, PRE, S); Genadendal *Burchell* 7665 (K, P); *Schlechter* 10319 (BM, BOL, G, GRA, K, P, PRE, S); Sondereinde River *Ecklon & Zeyher* 2402 (CTM, S). Bredasdorp: Elandskloof Mts. *Schlechter* 9776 (K, p. pte). Swellendam: Tradouw Pass *Adamson* 3888. Riversdale: Garcias Pass *Adamson* 4366. Prince Albert: Swartberg *Pocock* S116 (PRE).

20. **P. tenellus** Oliver Hook. Ic. t. 1460. 1884.

A very slender glabrous sprawling plant. Stems quite herbaceous, very thin, 10—50 cm. long, much branched, often forming tangled masses.

Leaves opposite, linear, distant, the lower 3—5 mm. long, the upper smaller: internodes 1—5 cm. long. Flowers in the axils of the upper leaves, solitary, on slender peduncles 0·5—3 cm. long. Peduncles spreading or divaricate. Flowering region up to 35 cm. long. Calyx lobes linear, glabrous, 2—3 mm. long, shortly connate at the base. Corolla white, campanulate, 5—6 mm. long, the lobes slightly shorter than the tube. Ovary 4 mm. long. Fruit 0·5—1·5 cm. long, often spirally coiled after dehiscence.

Damp sheltered places on the higher mountains in the Worcester region.

The type is *Rehmann* 2477 in herb Kew.

Quite unlike any other species in habit.

Worcester: Hex River Mts. *Rehmann* 2477 (BM, BOL, G, K), sn (BM, K); Milner Peak *Esterhuysen* 14856 (BOL); Audensberg *Esterhuysen* 16674 (BOL); Prospect Peak *Esterhuysen* 15935 (BOL); Fonteintjesberg *Esterhuysen* 16684, 19994 (BOL).

A single specimen (Bolus 8574 (K)) collected at Fairfield, Bredasdorp, is somewhat like this species but differs in having alternate leaves, shorter and wider calyx lobes, and a shortly hairy ovary. The specimen is labelled "*P. divaricatus*" but the material is insufficient for determination.

21. **P. nitidus** L'Hérit. Sert. Ang. 2. t.3. 1788.

P. Hookeri Sweet Hort. Bot. ed. 3. 419. 1839. *Campanula Prismatocarpus* Ait. Hort. Kew. 1. 224. 1789.

Low growing. Stems woody at the base, procumbent, branched, up to 35 cm. long, the younger densely leafy. Leaves alternate or subopposite, oblong or oblong-lanceolate, 0·7—2·2 cm. long, 2·5—4 mm. wide, firm, shining, glabrous, remotely serrate, the teeth obtuse but with very short hair points. Flowers sessile, axillary, in groups of 2—5, less often solitary. Bracts like the leaves but smaller. Calyx glabrous, the lobes acute, lanceolate, 3—4 mm. long. Corolla 0·8—1·5 cm. long, pale blue, the lobes separate, about as long as the tube. Filaments with a broadened truncate base, densely ciliate. Style hairy. Ovary 1—1·5 cm. long, longer than the subtending leaves. Fruit 1·5—2·5 cm. long, very narrow.

Rock crevices on the mountains of the Cape Peninsula.

The type is *Masson* in herb Brit. Mus.

Cape: Table Mt. *Adamson* 4453; *Anderssen* (S); *L. Bolus* (CT); *Burchell* 615 (G, K); *Ecklon* 155 (G, P), sn (G); *Ecklon & Zeyher* 16 (S), 2403 (CTM, S); *Harvey* (BM, K), 5020 (K); *Marloth* 3424 (PRE); *Wolley-Dod* 849 (K); *Schlechter* 505 (P); Blinkwater *Compton* 14441 (KIR); Window Gorge *Esterhuysen* 469 (KIR); Castle Rocks *Compton* 17913 (KIR); Cecilia Gorge *Cross* 2 (KIR); Devils Peak *Alexander* (BM); *Bolus*

3299 (BOL, CTM, GRA); *Esterhuysen* 10053 (BOL, KIR, PRE); *Gillett* 539 (K); *Guthrie* 1490 (CT); *O. Kuntze* (K); *Wolley-Dod* 676 (K); *Zeyher* 4902 (BOL, CTM); Noordhoek Mts. *Adamson* 2429 (CT); *Salter* 292/22 (BM), 7991 (BOL); Constantiaberg *Compton* 8562 (KIR); *Wolley-Dod* 677 (BM, BOL). WITHOUT LOCALITY: *Alexander* (K); "*Hort. Kew*" (CGE); *Lehmann* (P); *Masson* (BM, G); *Wahlberg* (S).

Specimens of this species collected by *Bowie* (BM) have had the locality "Tradouwberg, Swellendam" added to the sheets in pencil. There is doubt about its accuracy.

Var. **ovatus** Adamson var. nov.

A typo differt caulibus tenuioribus; foliis ovatis vel ovato-rotundis, minus confertis; floribus saepissime solitariis, plus minusve pedicellatis; calycis lobi tubo corollae distincte brevioribus; corollae lobis tubo vix longioribus.

More slender and more laxly branched than the common form. Leaves less crowded, ovate or rotund-ovate, 4—6 mm. long, 2—5 mm. wide, rather thin, not shining. Flowers solitary or rarely in pairs, often with long internodes and very small bracts. Pedicels 1—5 mm. long. Calyx lobes 2 mm. long, glabrous, shorter than the corolla tube. Corolla campanulate, 0·6—1 cm. long, the lobes not spreading, about as long as the tube.

Under rocks near the summits of mountains from the Hottentots Holland northwards to the Breede River.

The type is *Adamson* 3635 in herb Bolus.

STELLENBOSCH: Emerald Dome *Esterhuysen* 14376 (BOL), 14378 (PRE); Jonkershoek *Rodin* 3255 (BOL). PAARL: Wellington Sneeuwkop *Adamson* 3635. WORCESTER: Wildepaardeberg *Stokoe* (CTM).

A specimen collected by *Guthrie* (sn KIR) labelled as "George" is this variety. One of the specimens on the sheet *Zeyher* 4902 (CTM) is this; the variety has not otherwise been recorded for the Cape Peninsula.

22. **P. lasiophyllus** Adamson sp. nov.

Caules debiles prostrati basi solum lignosi pilosiusculi. Folia alterna, saepissime secunda, ovato-lanceolata, acuta, superne sparse sed infra dense hirsuta, marginibus revolutis remote serratis. Flores 1—3, terminales, sessiles. Bracteae foliis similes sed dentatae. Calycis lobi lanceolati, imbricati, hirsuti, tubo corollae aequilongi vel paulo longiores. Corolla late campanulata, lobis tubo subbrevioribus. Filamenta staminum basi dilatata subciliata. Stylus hirsutus, corollae aequilongus. Ovarium hirsutum.

Prostrate, herbaceous or slightly woody at the base. Stems up to

25 cm. long, thinly hairy, branching from the base and from near the top. Leaves alternate, ovate-lanceolate, 4—6 mm. long, 2—3 mm. wide, acute, thinly hairy above densely below, the margins revolute, remotely serrate. Bracts like the leaves but less revolute and with 1 or more large acute teeth near the base. Calyx lobes 3 mm. long, hairy, more or less imbricate, lanceolate, acute, as long as or slightly longer than the corolla tube. Corolla pale blue, 5—7 mm. long, widely campanulate, the lobes acute, slightly shorter than the tube. Filaments dilated at the base, ciliate at the top only. Style hairy, about as long as the corolla. Fruit hairy, 0·5—1 cm. long, distinctly narrowed at the ends.

Under bushes on the summits of mountains in the Langeberg between Swellendam and Riversdale.

The type is *Adamson* 3883 in herb Bolus.

Allied to *P. nitidus* but readily distinguished by the hairy revolute leaves, terminal flowers and toothed bracts.

SWELLENDAM: Lemoenshoek Peak *Adamson* 3877, 3883; Goede Hoop Peak *Esterhuysen* 14436 (BOL).

23. **P. cordifolius** Adamson sp. nov.

Caules hispidi decumbentes vel suberecti e basi ramosi. Folia laxe hispida, alterna, ovata, basi subcordata, serrato-dentata. Flores solitarii vel binati in axillis foliorum superiorum. Bracteae foliis similes sed minores et magis incisae etiam sublobatae: bracteolae subglabrae paulo dentatae vel subintegrae. Calycis lobi subacuti, ovato-lanceolati, glabri vel pilis perpaucis tecti. Corolla alba, campanulata, calyce multo longior, tubo lobis longiore. Ovarium bracteis aequilongum vel paulo longius.

Stems herbaceous or very slightly woody at the extreme base, purple, hispid, sprawling or less often erect, up to 60 cm. long, branched mostly from the base. Leaves scattered, alternate, thinly hispid, ovate, 0·5—1·3 cm. long, 0·4—0·8 cm. wide, sessile, more or less cordate at the base, serrato-dentate, acute. Flowers in the upper axils, sessile, solitary or in pairs. Bracts smaller than the leaves, less hispid, deeply toothed: bracteoles subglabrous, less toothed or almost entire, as long as or slightly shorter than the ovary. Calyx lobes ovate-lanceolate, subacute, slightly imbricate, about 3 mm. long, glabrous or with very few white hairs. Corolla white, campanulate, about 8 mm. long, the lobes half as long as the tube. Style almost as long as the corolla. Ovary thinly hispid, about 5 mm. long. Fruit up to 1 cm. long.

Swamps by steams on the mountains near the mouth of the Palmiet River.

The type is *Esterhuysen* 13674 in herb Bolus.

Appears to flower only after fires.

Caledon. Bettys Bay *Esterhuysen* 13674 (BOL, KIR, PRE); Paardeberg *Adamson* 4173.

24. **P. debilis** Adamson Journ. S. Af. Bot. 12. 37. 1946.

A slender decumbent or prostrate perennial forming loose tangles. Stems very slender, hispid, 10—40 cm. long, much branched. Leaves opposite or the upper alternate, oblong, ovate or rotund, 4—7 mm. long, 3—4 mm. wide, flat, sessile or minutely petiolate, dark green above, paler below, glabrous or thinly hairy, the edges with 1—2 acute setiferous serrations. Flowers in the upper axils, solitary or in pairs. Bracts like the leaves or commonly much smaller and separated by long internodes. Calyx lobes acute, 2 mm. long. Corolla campanulate, white, pale blue or pinkish, 4—7 mm. long, the tube as long as or longer than the lobes. Filaments flattened at the base, not or very minutely ciliate. Style hairy. Ovary glabrous. Fruit 1—1·8 cm. long.

Among rocks on the uppermost parts of mountains in the south-west.

The type is *Bolus* 7305 in herb Bolus.

Rather variable in size and in leaf-shape. All the leaves may be opposite or only those at the base. The flowers usually appear as if pedunculate owing to the long internodes separating the uppermost very small leaves (bracts) but are sometimes quite sessile.

Ceres: Olifants River Mts. *Esterhuysen* 13374 (BOL, KIR, K, PRE). Tulbagh: Gt. Winterhoek *Esterhuysen* 19793 (BOL). Worcester: Milner Peak *Esterhuysen* 14862 (BOL); Audensberg *Esterhuysen* 16672 (BOL); Waaihoek Peak *Esterhuysen* 15088 (BOL); Slanghoek Mts. *Wall* (S); Observation Peak: *Esterhuysen* 1712 (BOL); Upper Wellington Sneeuwkop *Adamson* 3606 (PRE); *Esterhuysen* 15031 (BOL). Paarl: Lower Wellington Sneeuwkop *Esterhuysen* (BOL); Haalhoek Spitzkop *Esterhuysen* 13536 (PRE), 13904 (BOL); Seven Sisters *Esterhuysen* 15307 (BOL). Caledon: Genadendal Mts. *Bolus* 7305 (BOL, GRA, K); *Burchell* 7341 (K, P), 7735 (K, P); *Schlechter* 10298 (BM, BOL, G, GRA, K, P, PRE, S), 9882 (BOL, GRA). Swellendam: Lemoenshoek Peak *Adamson* 3882.

Var. **elongatus** Adamson var. nov.

A typo differt caulibus robustioribus subrigidis; foliis majoribus inflorescentia elongata ramis subdivaricatis 2—4 floriferis; floribus majoribus.

A more robust plant than the ordinary form with subrigid prostrate stems up to 45 cm. long. Leaves mostly opposite, up to 1·2 cm. long and 0·5 cm. wide. Inflorescence elongated, up to 15 cm. long, with wide; spreading branches bearing 2—4 flowers. Flowers subsessile or shortly pedicellate. Calyx lobes flat, acute, ovate-lanceolate, about 3 mm. long. Corolla 0·6—1 cm. long.

Mountain slopes at the head of Michells Pass.

The type is *Schlechter* 9775 in herb Bolus.

CERES: Michells Pass *Bolus* 8337 (BOL, PRE); *Schlechter* 9775 (BOL, GRA, K, PRE).

SPECIES OF UNCERTAIN AFFINITY.

The two following species are placed at the end of the Series *Nitidi* on account of the leaf-like bracts but they are not at all nearly related to any of the others in the series nor to one another.

25. **P. lycioides** Adamson sp. nov.

Caules lignosi ramis subdivaricatis subpungentibus. Folia alterna plana ovata acuta superne glabra infra subhispida marginibus revolutis. Flores axillares numerosi parvi. Corolla alba infundibuliformis lobis tubo longioribus. Discus bilobus. Fructus subfusiformis.

An erect shrubby plant 40 cm. high, with almost divaricate branches ending in soft spines. Young stems shortly hairy. Leaves crowded, decreasing in size from below upwards, ovate, flat, 4—6 mm. long, 2—3 mm. wide, acute, ciliate at the base, glabrous above, hispid at least on the midrib below, the margins slightly revolute. Flowers numerous, small, in the axils of leaves. Calyx lobes lanceolate, 2 mm. long, 1 mm. wide at the base, acute, glabrous or slightly hairy. Corolla white, 4—6 mm. long, funnel-shaped, the lobes longer than the tube. Disc 2-lobed. Ovary minutely downy. Fruit about 0·5 cm. long, sulcate, narrowed at both ends.

In karroo-like vegetation on foothillls near Worcester.

The type is *Esterhuysen* 1909 in herb Bolus.

WORCESTER: Btn. Worcester and Villiersdorp *Esterhuysen* 1909 (BOL); Hammans Hof *Compton* 8850 (KIR).

A single specimen collected by Stokoe in the Pakhuis Pass (CTM 573487) is like this species but differs in being shortly hairy all over; in having the lateral branches not spinous; the scattered acute leaves strongly revolute; the flowers in the axils of bracts much shorter than the ovary; and a prismatic obtusely angled fruit not narrowed at the ends. It is probably an undescribed species but the material is without flowers and unsuitable for diagnosis.

26. **P. rhodesicus** Adamson sp. nov.

Herba annua ramosa. Folia alterna plana oblonga vel oblanceolata paucidentata. Flores axillares pedicellati. Calycis lobi subulati ciliati, tubo corollae leviter breviores. Corolla late campanulata alba lobis tubo longioribus.

An annual herb, 40—60 cm. high, with the habit of *Lobelia Erinus*. Leaves scattered, glabrous, oblong or oblanceolate, 2—4 cm. long, 3—8 mm. wide, with very occasional teeth on the margins. Flowers axillary, on pedicels 1—2 cm. long. Calyx lobes linear, subulate, 3 mm. long, ciliate with the hairs directed inwards, sometimes slightly toothed at the base. Corolla 0·5—1 cm. long, white, funnel-shaped, the lobes overlapping, one and a half times as long as the tube, the tube slightly longer than the calyx lobes. Filaments flattened at the base, the flat part extended laterally and ciliate at the top. Disc large, hemispherical. Style much longer than the stamens. Fruit 1·5 cm. long, somewhat narrowed to the base. Seeds ovoid.

Damp places in the Zambesi valley.

The type is *Flanagan* 3162 in herb Bolus.

Rhodesia: Victoria Falls *Allen* 118 (K); *Flanagan* 3162 (BOL, PRE); *Rogers* 5617 (BOL); Barotseland *Borle* 12 (PRE), sn (KIR).

A single specimen (*H. Curson* 710 (PRE)) from Ngamiland is an allied species. It is much branched, with scattered undulate linear leaves. The flowers are axillary, with the corolla divided half way. The disc is flat. Fruit clavate, distinctly narrowed from the top to the base.

Sub-gen. 2. Afrotrachelium Adamson s. gen. nov.

Perennes diffusae lignosae. Folia linearia. Inflorescentia pedunculata, aphylla, saepe ramosa, floribus numerosis parvis. Calycis lobi connati, corolla multo breviores. Corolla hypocrateriformis, lobis parvis patentibus plus minusve inaequalibus. Filamenta staminum basi haud dilatata. Discus minutus, planus. Stylus corolla multo longior.

Diffuse shrublets in habit resembling Series *Fruticosi* of *Euprismatocarpus* but more rigid and with smaller flowers. Calyx lobes connate. Corolla with a narrow cylindrical tube and small spreading often unequal lobes. Style distinctly longer than the corolla. Filaments of the stamens not dilated at the base. Disc small, flat.

The type species of the subgenus is *P. diffusus* (L.f.) A.DC.

KEY TO THE SPECIES.

1. Bracts shorter than the ovary: ovary and calyx glabrous.
    2. Inflorescence much branched: peduncle leafless: fruit linear: leaves glabrous .. .. .. 27. *diffusus*
    2. Inflorescence not or little branched: flowers secund: peduncle with leaves: fruit fusiform: leaves hairy .. .. 28. *pauciflorus*

1. Bracts as long as or longer than the ovary: ovary hairy.
  3. Leaves revolute, pungent: calyx hairy, the lobes linear .. .. 29. *pilosus*
  3. Leaves flat, toothed: calyx glabrous: the lobes lanceolate, imbricate .. .. 30. *fastigiatus*

27. **P. diffusus** (L.f.) A.DC Monog. Camp. 164. 1830.

Trachelium diffusum L.f. Supp. Pl. 143. 1781. *Lobelia laricina* Spreng. f. Tent. Supp. 9. 1828. *P. laricina* Presl Prod. Mon. Lob. 52. 1836.

Diffuse, much branched, in loose or close bunches. Stems woody at the base, the younger hairy. Leaves crowded, spreading, linear, 0·5—1·5 cm. long, 1—3 mm. wide, flat or concave above, rolled when dry, glabrous except for short stout white cilia in the lower part. Inflorescence leafless, 5—40 cm. long, usually rigid, glabrous, branched, the branches divaricate or spreading, the ultimate cymose. Flowers many, crowded or not, in cymose groups of 3 but often with additional flowers in the axils of the bracteoles. Flowers pedicellate but often apparently sessile owing to the branching. Bracts 2—3 mm. long, subulate: bracteoles smaller, often not opposite, on the pedicel and commonly just below the flower. Calyx glabrous, cup-like, about 3 mm. long, the free lobes erect, shorter than or as long as, rarely longer than the tube. Corolla violet, blue-violet or occasionally white, the tube about 1 cm. long, the lobes 3 mm. Stamens as long as the corolla tube. Style one and a half times as long as the corolla. Ovary glabrous, 0·5—1 cm. long. Fruit linear, cylindrical, 1—2 cm. long.

Among rocks on the lower slopes of mountains in the western and nothern districts, not extending eastwards. Rather common.

Variable in size and the form and extent of the inflorescence. Plants from exposed situations at high altitudes may be short and almost tufted; those from shaded places have little branched inflorescences. The inflorescence branches finally become hard and woody.

NAMAQUALAND: Leliefontein *Pearson* 6309 (BOL, CTM, K); Rietkloof Mts. *Pearson* 5720 (BOL, K). CLANWILLIAM: Pakhuis Pass *Esterhuysen* 14987 (BOL); *Leipoldt* 3711 (BOL); Kliphuis *Leipoldt* 3711 (PRE); Clanwilliam *Leipoldt* 4349 (KIR, PRE); Krakadouw *Adamson* 458, 459; Middelberg *Compton* 6233 (KIR); Cedarberg *Norman* 328 (BM); Suurvleiberg *Esterhuysen* 2494 (BOL, KIR, PRE); Elands Kloof *Esterhuysen* 4442 (BOL, PRE); *Leipoldt* (BOL); Olifants River Mts. *Leipoldt* (BOL); Greys Pass *Drège* 6324 (G, P); *Theiler* 51 (PRE). PIKETBERG: Versvelds Pass *Zinn* (CTM). CERES: Cold Bokkeveld Mts. *Adamson* 3137; Roodeberg *Compton* 8474 (KIR); Ceres *Guthrie* 2176 (KIR); *Thode* A2257 (K, PRE). TULBAGH: Gt. Winterhoek *Drège* (CTM), 6324 (BM, OXF, S), 6326 (BM, CGE, G, K, OXF, P, S); *Galpin* 12631 (PRE); *E. P. Phillips* 1795 (CTM); Kardouw *Zeyher* 1079 (BM, BOL, CTM, K, P, S), 1081 (CTM, P): Tulbagh *Rogers* 17327 (J); Tulbagh Kloof *Ecklon & Zeyher* (CTM), 2389 (G, OXF, P, S): *Ecklon* 994 (S); *Marloth* 5599 (PRE); *Pappe* (K); *Zeyher* 1021 (BOL, K, OXF); Waterfall *Bolus* 4059 (BOL): *Compton* 12439 (KIR); *Scott-Elliot* 221 (BM). WORCESTER: Hex River Mts. *Tyson* 799 (CTM. PRE); Waaihoek Peak *Wasserfall* 821 (KIR): Worcester *Zeyher* 1081 (CGE): Brand Vlei *Compton* 8633 (KIR): *Rehmann* 2408 (BM, K); Onklaarberg *Stokoe* 1096 (PRE); Du Toits Kloof *Adamson* 4461; *Drège* 6325 (BM, G, OXF, P. S); *B. Marloth* 9 (PRE): *Tyson* 925, 3053 (CTM); Bains Kloof *Acock* 2619 (S): *Hafstrom* (S); *Rogers* 29286 (J); *Wall* (S); Baviaans Kloof *Lewis* (PRE). PAARL: Wellington Sneeuwkop *B. Marloth* 46 (PRE): Bains Kloof *Adamson* 470, 3922: *Barker* 476 (KIR): *Bolus* 4059 (BM, BOL, K); *Compton* 8309 (KIR); *Esterhuysen* (PRE): *Garside* 443 (K); *Gillett* 791 (K); *Grant* 2257 (PRE); *Marloth* 12013 (PRE); *Rogers* 29286 (GRA); *Salter* 373 11 (BM): Berg River Hoek *Compton* 12986, 15648 (KIR); Franschhoek Pass *Compton* 12949, 12970, 8515 (KIR); *Gillett* 740 (K); *Leighton* (CTM, GRA, PRE); *Rodin* 3079 (BOL): *Salter* 1924 (BM, K), 2979 (BM. K); Gt. Drakenstein *Rogers* 10517 (BOL, G. J, K). MALMESBURY: Riebeck Kasteel *Pillans* 6102 (BOL); *Salter* 2016 (BM. K). STELLENBOSCH: Banhoek *Bond* 817 (KIR); Jonkershoek *Adamson* 3925; *Esterhuysen* 11485 (BOL, PRE); *Rodin* 3271 (BOL); Stellenbosch Mt. *Garside* 1208 (K); *Galpin* 10618 (G, K, PRE); Hottentots Holland *Burchell* 8280 (K); *Ecklon & Zeyher* (CTM, S); Helderberg *Galpin* 12311 (K, PRE); *Salter* 4225 (BM, K, PRE); Sir Lowry Pass *Adamson* 529; *Bolus* 4161 (BOL); *Gillett* 680 (K); *MacOwan* 2955 (CTM, GRA); *Schlechter* 7283 (PRE); Gordons Bay *Marloth* 10002, 10102 (PRE). CALEDON: Sir Lowry Pass *Compton* N.B.G. 76,48 (KIR); *Schlechter* 1160 (GRA), 7283 (BM, G, GRA, K, P, PRE, S); *Wall* (S); Steenbras *MacOwan* 2955 (CTM); *Moss & Rogers* 1531 (BM), 1550 (J); *Rogers* 10517 (GRA); *C. A. Smith* 7283 (PRE); Kogel Bay *Compton* 18949 (KIR); Houwhoek *Guthrie* 3662 (BOL); Hermanus *Gilman* 1963 (G); *Paterson* 19094 (BOL); Genadendal *Bolus* 633 (BM, BOL, G. GRA, K, P, PRE, CTM); *Burchell* 7807 (K); Sondereinde Mts. *Marloth* 8150 (PRE); Bosjesveld Mts. *Stokoe* (CTM), 7165 (PRE). VILLIERSDORP: *Adamson* 4138; *Galpin* 12323 (K, PRE). WITHOUT LOCALITY: *Balston* (BM); *Boivin* (P); *Ecklon & Zeyher* (CGE); "1:11" (GRA); *Drège* (G); *Masson* (BM, G); *Montini* (S); *Roxburgh* (G); *Swartz* (S); *Thunberg* (S); *Verreaux* (G, P); *Wallich* (BM, CGE, G, K, S); *Wallich & Hartmann* (S); *Zeyher* (P), 377 (G), 397 (P).

28. **P. pauciflorus** Adamson sp. nov.

P. diffuso differt foliis minoribus pilosis; inflorescentia ex caule gradatim emergente; floribus paucis secundo-racemosis; fructibus fusiformibus.

Smaller and less branched than *P. diffusus.* Stems and lower leaves densely covered with short hairs. Leaves linear, pilose, appressed, 3—4 mm. long, the upper glabrescent. Axillary fascicles usually present. Inflorescence unbranched, emerging gradually from the stem, the upper leaves on the peduncle smaller and more distant. Flowers pedicellate, 3—6 in a secund raceme. Bracts 2 mm. long. Pedicels 4 mm. Calyx glabrous, 3 mm. long, the lobes linear, erect, twice as long as the tube. Corolla pale violet, the tube very slender, 7—8 mm. long, the lobes 3 mm., narrow, almost equal. Style twice as long as the corolla tube. Fruit 0·8—1 cm. long, distinctly narrowed at the ends.

Endemic to the Cedarberg. On rocks at 3,000—4,000 ft.

The type is *Esterhuysen* 13815 in herb Bolus.

Clanwilliam: Wolfberg (Cedarberg) *Esterhuysen* 13815 (BOL, K, PRE).

29. **P. pilosus** Adamson sp. nov.

P. diffuso similis sed differt caulibus pilosiusculis; foliis subpungentibus; floribus subracemosis; calycibus et ovariis dense pilosis; calycis lobis acuminatis basi tantum connatis; stylo corolla fere duplo longiore.

An almost prickly rather rigid diffuse shrublet. Stems hairy. Leaves rigid, linear, acicular, ciliate at the base, involute and subpungent, 1—2 cm. long, often with axillary fascicles. Inflorescence stout, up to 35 cm. long, hairy, either unbranched or with alternate short divaricate branches 2—3 cm. long. Flowers often crowded, apparently racemose, at the tips of the stem and branches, pedicellate. Pedicels 1—5 mm. long. Bracts subulate, 0·5—1 cm. long, as long as or longer than the ovary: bracteoles 1—2 mm. long, at the top of the pedicel. Ovary and calyx densely covered with very short hairs. Calyx lobes linear, acuminate, about 3 mm. long, connate for less than a third their length. Corolla white or pale violet, the tube 0·5—0·7 cm. long, the lobes short, obtuse, distinctly unequal. Style twice as long as the corolla. Fruit 0·7—1 cm. long, narrowly fusiform.

Rocky mountain slopes in the Cold Bokkeveld and adjacent ranges.

The type is Adamson 4107 in herb Bolus.

In the later stages the inflorescence hardens and the branches become almost spinous.

Ceres: Cold Bokkeveld Mts. *Adamson* 1536, 1538 (PRE), 3138, 4106, 4107, 4108, 4111, 4113, 4117, 4118, 4127; Zandfontein *Barker* 4466 (KIR).

30. **P. fastigiatus** Presl ex A.DC. in DC. Prodr. 7. 442. 1839.

Like *P. diffusus* but stouter, more rigid and less branched. Stems hairy, up to 50 cm. high. Leaves scattered, linear, 2—3 cm. long at the base, smaller above, glabrous, concave above, minutely keeled below, the edges with distant pairs of small teeth. Inflorescence stout, unbranched or with few short branches, the peduncles bare or a few scattered bracts like the leaves but smaller and entire. Flowers crowded in spike-like groups, on minute pedicels. Bracts 4—6 mm. long, ovate, clasping, cuspidate, glabrous or ciliate, entire or toothed, as long as the pedicel and ovary; bracteoles similar but smaller, at the base of the pedicel. Calyx glabrous, the lobes lanceolate, imbricate, united for a third their length. Corolla white or pale violet, the tube 0·5—0·7 cm. long, about one and a half times as long as the calyx lobes, the lobes very short, subequal. Style about twice as long as the corolla tube. Ovary shortly hairy. Fruit 0·5—0·7 cm. long.

Rare. Only known from the collections of *Drège* from Uienvallei in the Caledon-Bredasdorp area.

The type is *Drège* in herb DC, Geneva.

CALEDON. Uienvallei *Drège* (BM, CGE, G, K, OXF, P, S).

EXCLUDED SPECIES.

P. junceus Buek in E. & Z. Enum. 383. 1837. is *Lightfootia juncea* Sond. Fl. Cap. 3. 563. 1865.

P. junceus Schinz Mem. Herb. Boiss. 20. 35. 1900 *non* Buek is a doubtful species, in appearance like *P. campanuloides*. As it was described as having a trilocular ovary it probably does not belong to the genus It was collected on rocky slopes in Great Namaqualand, S.W.A.

The following species belong to the genus *Specularia*:—

P. confertus Moench. Meth. Pl. 496. 1794.
P. cordatus Reichb. f. Fl. Ger. Excurs. 858. 1832.
P. falcatus Ten. Prod. Fl. Nap. 16. 1823.
P. hirtus Ten. l.c.
P. hybridus L'Hérit. Sert. Ang. 3. 1788.
P. pentagonus L'Hérit. l.c.
P. perfoliatus Sweet Hort. Brit. 1. 251. 1827.
P. scaber Lowe Trans. Camb. Phil. Soc. 6. 10. 1838.
P. Speculum L'Hérit. Sert. Ang. 3. 1788.

Since the above was in the press the following has come to hand:—

P. implicatus Adamson sp. nov.

P. tenello affinis sed differt caulibus longioribus; inflorescentia perlonga; corolla saepius 4-mera, lobis tubo duplo longioribus; staminibus brevibus filamentis non dilatatis; fructibus clavatis non spiraliter tortis; seminibus laevibus.

Larger and less delicate than *P. tenellus.* Flowering region up to 50 cm. long, with internodes 2—5 cm. long. Peduncles opposite, divaricate, each with 2—3 rarely 1 flowers. Bracts like the leaves but smaller. Flowers pedicellate, with a pair of bracteoles at or above the middle, commonly 4-merous but some 5-merous. Calyx lobes 1 mm. long, acute, not obviously connate. Corolla white or tinged with pink or purple at the tip, campanulate, 5—6 mm. long, the acute lobes twice as long as the tube. Stamens with slender not dilated filaments. Style slightly thickened upwards. Ovary clavate, distinctly narrowed to the base. Fruit rather swollen, 5—6 mm. long, the segments not twisted. Seeds few, oblong, obtuse-ended, quite smooth.

In tangles on sheltered rocks on mountains in the Tulbagh area. The type is *Esterhuysen* 16918 in herb. Bolus.

Tulbagh: Gt. Winterhoek *Esterhuysen* 16918 (BOL).

ROELLA

L. Sp. Pl. 170. 1753.

Shrublets, less often herbs. Leaves small, simple, usually linear, crowded or scattered, very often with axillary fascicles of smaller leaves. Flowers terminal, solitary or in groups, most often surrounded by bracts (floral leaves). Flowers regular, bisexual. Stamens not epipetalous, the filaments dilated and usually ciliate at the base. Ovary inferior, 2-chambered: ovules numerous. Stigma 2-fid. Disc flat, concave or bulged upwards. Fruit dry, opening by a hole or pore at the top at the position of the base of the style.

Rather variable in habit but most commonly ericoid. In many species the majority of the axillary buds produce very short shoots with tufts of leaves, branches being confined to buds at the base or just below the flower heads. Stout white setose hairs are a common feature, sometimes accompanied by smaller hairs. On the leaves, bracts and calyx lobes these marginal setae are accompanied by and show transitions to narrow tooth-like projections.

The type species is *R. ciliata* L.

The species fall into a number of series characterized by features of habit, bracts and flowers.

KEY TO THE SERIES.

1. Flowers not surrounded by bracts: stems mostly herbaceous .. .. 5. Muscosae

1. Flowers surrounded by bracts: stems woody.

  2. Bracts like the leaves but often more crowded .. 2. Prostratae

  2. Bracts unlike the leaves in size or form.

3. Bracts many, not much widened at the base: corolla usually over 1·5 cm. long .. .. 1. CILIATAE
3. Bracts few: corolla rarely over 1·5 cm. long.
  4. Bracts not broad-based: flowers solitary 2. PROSTRATAE
  4. Bracts broad-based and clasping: flowers usually in heads.
    5. Leaves linear, not decurrent .. 3. SPICATAE
    5. Leaves ovate or lanceolate, decurrent 4. SQUARROSAE

Series 1. CILIATAE.

Flores solitarii vel raro binati ternative, bracteis numerosis circumdati. Bracteae foliis latiores, non amplexicaules. Calycis lobi magni, persistentes et tandem amplificentes. Corolla late campanulata, saepe 1·5 cm. longa.

Stems woody. Leaves linear, ciliate with stout white hairs or with narrow pinnate teeth, the midrib below slightly projecting. Flowers solitary or less often in groups of 2 or 3, not in definite heads. Bracts numerous, larger than the leaves but not broad-based or clasping. Calyx lobes large, usually toothed, persistent and enlarged at the fruiting stage. Corolla rather widely campanulate, usually over 1·5 cm. long.

Most commonly erect or suberect. Stems branched mostly from below the flowers. Several of the species have variants with small flowers. 4- or 6-lobed corollas occur occasionally. In many the leaves are soon deciduous, only the axillary tufts persisting. Hybridization between associated species appears to occur.

KEY TO THE SPECIES.

1. Bracts green, either ciliate or with narrow but not hair-like teeth.
  2. Bracts and calyx lobes covered with short hairs on the back: corolla with dark spots between the lobes: ovary hairy .. .. 4. *maculata*
  2. Bracts and calyx lobes glabrous on the back or with stout setose hairs only: corolla concolorous or with dark spots on the lobes or a continuous dark band.
    3. Bracts narrow, edged with stout white setose hairs, not toothed or only the innermost with occasional teeth near the tip.
      4. Robust: corolla 1·5 cm. long or more, with a dark band: bracts 1 cm. or more long: ovary glabrous .. .. 1. *ciliata*

4. Slender: corolla not over 1 cm. long, concolorous or rarely with spots: bracts 0·5 cm. long: ovary hairy .. .. 8. *Dunantii*

3. Bracts pinnately toothed.

5. Bracts crowded, forming a distinct bulge below the flower: calyx lobes glabrous or with stout setose hairs .. .. .. 2. *incurva*

5. Bracts less crowded, not forming a bulge below the flower: calyx lobes ciliate.

6. Corolla blue, concolorous: calyx lobes narrow, acuminate: bracts rigid, with distant pinnate teeth .. .. .. 2. *incurva* var. *rigida*

6. Corolla red or pink with blue spots on the lobes: calyx lobes with pinnate teeth near the tip only: bracts with long pinnate teeth .. .. .. 3. *rhodantha*

1. Bracts brown and dry or becoming so when the flower opens, pinnate with long hair-like teeth: ovary hairy.

7. Corolla with a dark band at the base: bracts and calyx lobes covered with short hairs on the back: bracts not hair-pointed .. .. 5. *triflora*

7. Corolla concolorous: bracts with long hair-like points.

8. Calyx lobes much longer than the bracts, covered on the back with short hairs: bracts closely pinnate .. .. 6. *Dregeana*

8. Calyx lobes not longer than the bracts, ciliate but otherwise glabrous: bracts with distant pinnate teeth .. .. 7. *psammophila*

1. **R. ciliata** L. sp. Pl. 170. 1753. *emend.* A.DC. Monog. Camp. 173. 1830.
R. ciliata var. *Linnaeana* Sond. Fl. Cap. 3. 591. 1865.

Stems hairy, woody, sprawling, ascending or erect, up to 50 cm. long. Branches often divaricate, mostly from below the flower heads. Leaves usually crowded, 0·5—1 cm. long, 2—4 mm. wide, flat, narrowed from the base to the tip, more or less rigid, erect or spreading, the edges with few or many stout white setose hairs. Flowers usually solitary. Bracts numerous, not forming a distinct bulge below the flower, flat, narrowed from base to tip, 0·5—1·5 cm. long, acute, closely edged with stout white setose cilia, occasionally with a few setose hairs on the back, otherwise glabrous. Innermost bracts occasionally with a few narrow pinnate teeth near the tip. Calyx lobes oblong-lanceolate, acuminate, 3—6 mm. wide, much longer than the bracts, ciliate, often with stout hairs on the midrib but otherwise glabrous, the middle and upper parts with narrow lateral teeth. Calyx lobes at flowering time as long as or longer than the corolla tube. Corolla widely campanulate, 1·5—4·5 cm. long, most commonly 2—2·5, the lobes contiguous, rounded or slightly mucronate at the tip, about one and a half times as long as the tube. Corolla blue or blue-violet, occasionally white, with dark marks at the base of the lobes or more often a continuous dark band, the dark part often edged with white. Ovary glabrous. Fruit with a rigid rim round the central pore.

The type is in herb Linn.

While rather variable in habit and flower size, the species is readily distinguished by the bracts. As described the species agrees with the Linnaean type. The earlier collectors had a wider connotation, the restriction being first recognized by A. DeCandolle (l.c.).

The curious pinkish colour of the corolla depicted in the plate in Bot. Mag. (378. 1797) has not been observed in wild plants but is exactly reproduced when flowers are kept in a box, and frequently appears on drying.

Flats and lower mountain slopes, either on sand or among rocks in the extreme south-west. Common on the Cape Peninsula, less so inland.

Hybrids with *R. triflora* and *R. prostrata* have been observed (cf. under those species).

TULBAGH: Saron *Schlechter* (S); Waterfall *Pappe* (CTM). WORCESTER: Du Toits Kloof *Drège* (G). PAARL: Paarlberg *Drège* (S); Wellington *A. L. Grant* (K, PRE); *J. B. Thomson* (PRE); Franschhoek *W. J. Louw* 133 (KIR); *Moss* 7554 (BM, J); Wemmershoek *Moss* 24891 (J). STELLENBOSCH: Kraaifontein *Acock* 3962 (S); Kanonberg *Acock* 1255 (S); Jonkershoek *Adamson* 3926, 3927; *Garside* 1167 (BOL, K); Sir Lowry's Pass *Adamson* 4037, 4045, 4158; *Schlechter* 7282 (BOL, K). CAPE: Doornhoogte *Zeyher* 748 (S), 3417 (S); *Ecklon & Zeyher* 2406 (CTM, p. pte); N'dabeni *Adamson* 3315; *Salter* 8710 (BOL), 8710 (KIR); Cape Flats *Ecklon & Zeyher* 2405 (CTM); *Pappe* (CTM); *Zeyher* (CTM); Seekoe Vlei *Ecklon* 81 (G, K); Cape Town *Balston* (BM, p. pte); *Burchell* 96 (K); *de Castelnau* 370, 447 (P); *R. E. & Th. Fries* 3001 (S.); *Paterson* 92 (GRA); *von Ludwig* (PRE); Table Mt. *Bolus* 86 (BOL); *Brown* (BM); *H. M. Cameron* (J); *Debeaux* (P); *Ecklon* 64 (G), 694 (P, S); *Esterhuysen* 28393 (PRE); *Harvey* 11 (K); *O. Kuntze* (G, K); *Leotard* (P); *MacGillivray* 657 (K); *MacOwan* 86 (K, P); *Milne* 181 (K); *Moss* 7561 (BM, J); *M. M. Page* (CT); *Rogers* 16985 (J); *Ryder* 154 (K); *Schlechter* 10 (CGE, GRA, P); *Scott-Elliot* 95

(PRE); *Shantz* 60 (K); *Wall* (S); *Zeyher* (S); Kloof Nek *Moss* 9019 (BM, J); Lions Head *Adamson* 3939; *Wilms* 3390 (K); Camps Bay *Alexander* (K); *Barker* 2431 (KIR); *Marloth* 5933 (PRE); *Naude* 49 (K); Bakoven *Hafstrom* (S); Llandudno *Wall* 999/9 (S); Hout Bay *Drège* (G); Devils Peak *Bolus* 3323 (BOL); *Rehmann* 1045, 1046 (BM); *Tyson* 2343 (BM); *Wolley-Dod* 182 (BM, BOL, K); Raapenberg *Guthrie* 998 (CT); *Wilms* 3890 (G); Rondebosch *Adamson* 670, 4025; *Levyns* 3129 (CT); *MacOwan* 2366 (CTM); *Marloth* 405 (PRE); Newlands *Adamson* 4034; *Esterhuysen* 15191 (BOL, PRE); Kenilworth *O. Kuntze* (K); Wynberg *Wallich* (BM); Wynberg Hill *Burchell* 874 (K); *Salter* sn, 2038 (K); Kirstenbosch *Adamson* 3928, 4020; *Barker* 199 (KIR, PRE); *Esterhuysen* 48, 48A (KIR); *Henderson* 1404 (KIR); *Moss* 17465 (J); Steenberg *Burchell* 8532 (K); Muizenberg *Arbuthnot* (CT); *Penther* 2736 (S); *Rogers* 1069 (GRA); Kalk Bay *Moss* 5056 (BM, J); Fish Hoek *Galpin* 4308 (PRE); Red Hill *Adamson* 689; Simonstown *Jamieson* (OXF, p. pte); *Wright* (K, P); Kommetjie *Galpin* 4308 (GRA); Buffels Bay *Adamson* 686 (PRE); Cape Point *Godman* 856 (BM). CALEDON: Swartberg *Ecklon* 81 (S), 2405 (BM, BOL); *Ecklon & Zeyher* (CTM, S); *Zeyher* (S). WITHOUT LOCALITY: *Anderssen* (S); *Banks & Solander* (BM); *Boivin* (P); *Burman* (G); *Commerson* (G); *Cosson* (P); *Drège* (BM, CGE, CTM, G, K, OXF, P); *Delessert* (G, P); *Ecklon* 2445 (G, OXF); *Ecklon & Zeyher* "92:10" (GRA); *Elliot* 63, 113 (G); *Forster* (K); *Forsyth* (K); *Gaudichaud* (P); *Gay* (K); *Genevier* (CGE); *Hartmann* (S); *Harvey* 454 (K), sn (BM); *Lalande* (P); *Lehmann* (P); *Lesson* (P); *Niven* (S); *Pappe* (K); *Peters & Stewart* (BM); *Poiret* (P); *Reeves* (CGE); *Richard* (P); *Ryder* (K); *Sieber* 78 (P); *Sonnerat* (P); *Steudel* 2405 (P); *Thunberg* (S); *Vaillant* (P); *Verreaux* (G); *Wallich* (BM, CGE, G, K); *Wallich & Hartmann* (S); *Yorke* (K); *Zeyher* (CTM). CULTIVATED: *Henslow* (CGE); "Hort. Paris" (G).

A record from Algoa Bay (*Lawson* (OXF)) requires confirmation as to the locality.

2. **R. incurva** A.DC. Monog. Camp. 172. 1830.

R. ciliata var. *incurva* Sond. Fl. Cap. 3. 591. 1865.

Much like *R. ciliata* but more erect and with ascending branches. Stems hairy, up to 40 cm. high. Leaves fasciculate, soon drying and often falling off, rigid, spreading or erect, often incurved, ciliate at the base, often with 1—2 pairs of linear teeth near the tip. Flowers solitary or in groups of 2 or 3. Bracts usually forming a distinct bulge 0·5—2 cm. long below the flower, most often incurved, pinnately toothed with close or distant, rigid, straight or curved teeth. Bracts usually ciliate at the base, sometimes all along, either glabrous on the back or with coarse white hairs. Calyx lobes longer than the bracts, broadly lanceolate, 1—2 cm. long, 3—5 mm. wide, acute or acuminate, glabrous or with a few stout hairs on the back, edged with narrow pinnate teeth. Corolla campanulate, 1·5—2·5 cm. long, white or blue, the lobes rather narrow, acute, longer than the tube, often marked by a dark blue spot, the spots large or small, sometimes white-edged, sometimes wanting. Disc flat. Style hairy. Ovary glabrous. Calyx in fruit red-brown or purple.

Common and widespread on the mountains in the south-west.

The type is *Bowie* in Herb. B.M.

Readily distinguished from *R. ciliata* by the bracts, and the corolla with narrow acute lobes. Variable in habit, hairiness, bract shape and flower colour. Some of the extreme forms look distinct but are connected by all stages of intermediate. The bracts may be glabrous or hispid, short or elongated, with the teeth closely set or distant. The forms appear to be races and some to be geographically separate. The flower colour appears to vary independently of the bract features. While corollas with dark spots on the lobes are commonest there is a wide range in the size of the spots and quite concolorous corollas are frequent.

Presumed hybrids with *R. maculata*, *R. psammophila* and *R. rhodantha* have been observed.

TULBAGH: Tulbagh *Rogers* 17405 (G); Waterfall *Zeyher* (S). WORCESTER: Onklaarberg *Marloth* 110 (PRE). PAARL: Franschhoek Pass *Adamson* 4081, 4084, 4091; *Compton* 8173 (KIR); *Galpin* 12293 (K, P, PRE); *Martin* 622 (KIR); *Pillans* 6750 (BOL, K); *Salter* 4175, 4176 (BM); Franschhoek *Thode* A2210 (K, PRE); Berg River *Zeyher* (S). CAPE: Cape Town *Balston* (BM, p. pte); Simonstown *Jamieson* (OXF, p. pte). STELLENBOSCH: Simonsberg *Ecklon* (S); Jonkershoek *Adamson* 3841, 4051, 4089; Hottentots Holland *Bowie* (BM); Lourensford *Esterhuysen* 3511 (PRE). CALEDON: Sir Lowry Pass *Adamson* 4145, 4146, 4147, 4148, 4149, 4150, 4151, 4152, 4153, 4154, 4155; *Ecklon & Zeyher* (S); *Zeyher* 695 (S); Steenbras *Adamson* 3859, 4032; *Salter* 5225 (BM, K), 5214A (BM, K); Steenbras Mouth *Adamson* 4030; *Salter* 5214 (BOL, GRA, K), 5219 (BOL, K); Koel Bay *Adamson* 4028; *Barker* 5279 (KIR); *Compton* 18956 (KIR); 20440 (KIR); *Leighton* 2463 (PRE); Hangklip *Adamson* 4412; *Pillans* 8195 (BOL, p. pte, K); Pringle Bay *Adamson* 4218; Palmiet River *Adamson* 3850, 3853, 3860, 4048, 4049, 4162A, 4163, 4168, 4169, 4170, 4177, 4179, 4182, 4186, 4206, 4207, 4211, 4212, 4213, 4219, 4458, 4459, 4460; *Barker* 1200 (KIR); *Esterhuysen* 12616 (BOL); Kleinmond *Compton* 12377 (KIR); Hermanus *Compton* 14257 (KIR); *Esterhuysen* 4228 (BOL); *Gillett* 625 (BOL); *Gilmore* 20749 (G); Mossel River *L. Guthrie* (PRE); *Potts* 5016 (CTM); Klein River *Adamson* 4128, 4129; Hemel-en-Aarde *Adamson* 4451; *Gillett* 561 (BOL); Shaws Mt. *Adamson* 4445; Grabouw *Britten* 3114 (GRA); Viljoens Pass *Adamson*

4143A, 4144; *Burchell* 7957 (K); *Gillett* 687, 688 (BOL, K); *Rodin* 3101 (BOL); *Salter* 2029 (BM, K); Houwhoek *Adamson* 4418, 4419, 4420; *Bowie* (BM); *Zeyher* 3149 (CTM, K, S); Bot River *Adamson* 4098, 4100, 4101, 4103, 4104; Caledon *Ecklon & Zeyher* 4314 (PRE, p. pte); Swartberg *Ecklon & Zeyher* 2405 (S); 2407 (CTM); *Pappe* (S); Genadendal *Drège* (G); Bosjesveld Mts. *Burchell* 7884 (K); *Stokoe* (CTM); Villiersdorp *Adamson* 4135, 4136, 4137, 4140, 4141, 4142, 4176, 4186; Aries Kraal *Barker* 3343 (KIR); *Compton* 16819 (KIR); *Leighton* 901 (BOL). BREDASDORP: Elandskloof Mts. *Adamson* 4321; *Galpin* 12294 (K, PRE); Ratel River *Bolus* (BOL, p. pte); Grashoek *Wall* (S); Elim *Bolus* 8570 (K, p. pte); Bredasdorp *Galpin* 11302 (K, PRE); Zondagskloof *Compton* 10229 (KIR). ROBERTSON: Sondereinde Mts. *Adamson* 4301, 4307, 4317. WITHOUT LOCALITY: *Auge* (BM); *Bonpland* (P); *Burman* (G); *Burtt-Davy* 18532 (PRE), 18566 (PRE); *Drège* 7837 (S); *Ecklon* 286 (S); "Hort. Kew" (CGE); *Lalande* (P); *Lindley* (K); *Moss* 7433 (J); *Niven* (S); *Oldenburg* (S); *Peters & Stewart* (P); *Sparrman* (S); *Thunberg* (S); *Waldegrave* (BM); *Zeyher* 9 (K), 694 (S), 1000 (K).

Var. **rigida** Adamson var. nov.

A typo differt bracteis angustis rigidis distanter pinnato-dentatis; calycis lobis angustioribus acuminatis pinnato-dentatis, ciliatis; corolla concolore.

A rather rigid erect or sprawling plant. Flowers solitary. Bracts lax, rigid, 1 cm. or more long, narrow, with distant rigid pinnate teeth. Calyx lobes narrow, acuminate, completely ciliate. Corolla blue concolorous, the lobes shorter than the tube. Style slightly thickened below the stigma.

A local variety confined to the Potteberg Range.

The type is *Adamson* 3892 in herb. Bolus.

SWELLENDAM: Potteberg *Adamson* 3891, 3892, 3898, 3897, 3905; *Compton* 20411 (KIR).

3. **R. rhodantha** Adamson sp. nov.

Erecta vel diffusa, ramosa, caulibus hirsutis. Folia fasciculata ciliata apice pinnato-dentata saepissime dorso hispida. Flores solitarii. Bracteae numerosae sublaxae planae rigide pinnato-dentatae. Calycis lobi lati pinnato-dentati ciliati apice intus hirsuti. Corolla rubra vel rosea, lobis coeruleo-maculatis, tubo lobis longiore vel aequilongo. Staminum filamenta basi dilatata et ciliata, apice plerumque retusa. Stylus hirsutus, sub stigmate lateraliter incrassatus. Ovarium glabrum.

A sprawling or suberect shrublet with wide-spreading branches. Stems hairy. Leaves rather rigid, squarrose or ascending, 2 mm. wide, ciliate, with remote pinnate teeth near the tip, the midrib usually with stout hairs below. Flowers solitary. Bracts many, rather lax, rigid, flat, 2 mm. wide, edged with rigid, pinnate, often ascending teeth, the innermost often with stout hairs on the back. Calyx lobes longer than the bracts, connate at the base, flat, lanceolate, glabrous on the back, hairy inside the acuminate tip, with narrow pinnate teeth on the upper half, ciliate on the lower. Corolla red or pink, with blue spots on the lobes, 1·5—3 cm. long, the lobes subacute or apiculate, about as long as the tube. Filaments with the flattened base ciliate and usually retuse at the top. Style hairy, with two small lateral bulges below the stigma. Disc cup-like. Ovary glabrous.

A distinct species apparently confined to the Potteberg range. The form with red flowers is confined to a small area in the north-west of the range, the pink flowered plant is more widespread.

The type is *Adamson* 3777 in herb. Bolus.

SWELLENDAM: Potteberg *Adamson* 3777, 3893, 3894, 3903, 3917; *David* (KIR); *Pillans* 9441 (BOL).

R. incurva × rhodantha.

Both the red and the pink flowered plants hybridize freely with *R. incurva* and its var. *rigida* where the species occur together, and a large series of intermediates occur in such situations. While the blue flower colour of *R. incurva* appears to be dominant, in other features the hybrid swarm covers a complete set of gradations from one species to the other. Some of the blue-flowered hybrids show a pink coloration on fading.

POTTEBERG: *Adamson* 3904, 3912, 3915, 3916, 4309, 4313, 4315, 4317A.

4. **R. maculata** Adamson sp. nov.

Fruticosa. Caules hirsuti ramosi. Folia fasciculata hirsuta dentata. Flores saepissime binati. Bracteae hirsutae, acuminatae, apice pinnato-dentatae. Calycis lobi hirsuti bracteis longiores. Corolla infundibuliformis, lobis latis, rotundatis, tubo brevioribus vel aequilongis, tubo inter lobos maculato. Stylus sub stigmate incrassatus. Ovarium hirsutum.

Stems much branched, often forming close bunches or tufts, rarely over 25 cm. high. Leaves crowded, erect or ascending, hairy at least when young, flat at the base but subulate at the tip, 5—9 mm. long, usually with distant linear teeth, ciliate at the base, the midrib below broad and slightly prominent. Flowers on the main stem and on short branches, most commonly in pairs, less often solitary or in groups of 3 or 4. Bracts rather lax, usually hairy, lanceolate-acuminate, with slender distant pinnate teeth on the upper part, ciliate at the base, the cilia reversed. Calyx lobes longer than the bracts, hairy, distinctly connate at the base, ovate-acuminate, ciliate, either entire or with remote linear teeth. Corolla funnel-shaped, 2—2·5, rarely 3 cm. long, violet or violet-blue, with large dark spots on the tube between the lobes. Corolla lobes as wide as long, rounded at the tip, as long as or shorter than the tube. Filaments very shortly ciliate on the widened base. Disc flat, glabrous. Style with a distinct lateral bulge below the stigma. Ovary hairy. Fruit 5—6 mm. long.

On sandy soils on the lower mountain slopes in the Palmiet River basin.

The type is *Adamson* 4160 in herb. Bolus.

CALEDON: Steenbras Siding *C. A. Smith* 2524 (K, PRE); Elgin *Adamson* 3920; Palmiet River *Adamson* 3851, 3857, 3921, 4160, 4161, 4178; *Esterhuysen* 12595 (BOL, PRE); *Gillett* 618 (BOL); *Levyns* 2695 (CT); *Pillans* 8206 (BOL); Hangklip *Pillans* 8195 (BOL, p. pte); Kleinmond *Salter* 5172 (BM, BOL, K). WITHOUT LOCALITY: *Moss* 7433*bis* (J).

R. incurva × maculata.

Plants referable to this hybrid occur occasionally where the two species are associated and constitute a series of connecting forms. The majority of the hybrids have glabrous leaves; flowers in heads; bracts usually glabrous but in form showing all intermediate stages; calyx lobes ciliate and usually with stout hairs on the back; and corolla concolorous or with markings like *R. incurva* but funnel-shaped; and a more or less hairy ovary.

CALEDON: Palmiet River *Adamson* 3852, 3854, 3855, 3856, 3861, 4047, 4167, 4205, 4456, 4457.

5. **R. triflora** (Good) Adamson comb. nov.

R. ciliata var. *triflora* Good J. Bot. 62. 48. 1924. *R. Dregeana* auct. *non* A.DC. (e.g. Adamson in Adamson & Salter Fl. Cap. Pen 743. 1950). *R. ciliata* var. *Dregeana* Sond. Fl. Cap. 3. 591. 1865 (p. pte).

Usually erect. Stems hairy, with ascending branches usually in groups, either from the base or from near the top. Leaves ascending or incurved, short, 3—6 mm. long, flat, narrowed from the base to the tip, acute, often covered with very short hairs, usually with distant pinnate teeth, the midrib below more than three-quarters the width of the leaf. Axillary tufts of small leaves usually present. Flowers solitary or in groups of 2 or 3, the groups sometimes clustered. Bracts many, covered with very short hairs, 5—6 mm. long, with long narrow pinnate teeth in the upper part and short cilia in the lower. Bracts green when the flower opens but soon becoming brown and dry. Calyx lobes covered with short hairs on the back, much longer than the bracts, 0·5—1 cm. long, broadly lanceolate or ovate-lanceolate, acute, with linear pinnate teeth. Corolla 1—1·5 cm. long, campanulate, pale blue with a dark band at the base, the lobes as long as or slightly longer than the tube. Style hairy. Disc cup-like. Ovary hairy. Calyx lobes at the fruting stage enlarged and usually red or reddish.

Sandy soils in the southern part of the Cape Peninsula.

The type is *Moss* 7507 in herb. Brit. Mus.

Rather variable in size and habit. The corolla is slightly hairy externally. Double flowers occur occasionally. There has been confusion with this species. Sonder included it under his variety *Dregeana* of *R. ciliata* and his epithet was adopted when the plant was raised to specific rank. It is not, however, the real *R. Dregeana* A.DC. The epithet adopted is the earliest that is unambiguous, though not specially apt. The species hybridizes with *R. ciliata*.

CAPE: Table Mt. *Prior* (K); Groot Kop *Andreae* 1089 (PRE); Vlaggenberg *Adamson* 1763, 1764 (CTM); *Salter* 1905 (BM, BOL, K); *Schlechter* 209 (BM, P, PRE); Noordhoek Mts. *Adamson* 2433; *Salter* 2000 (BOL); Constantiaberg *Barker* 698 (KIR); *Compton* 20375 (KIR); Steenberg *C. B. Fair* (BOL); *L. Bolus* (PRE); Muizenberg *Bolus* 4714 (BOL, K); *Compton* 14287 (KIR); *Guthrie* (BOL), 1375 (CT); *Salter* 292 11 (BM, BOL), 292 11B (BM), 1883 (BOL); *Wolley-Dod* 2320 (BM, BOL, K); Kalk Bay Mts. *Adamson* 2398 (CT, PRE); *L. Bolus* (CT); Simonstown *MacGillivray* 658 (K); *Milne* 213 (K); Red Hill *Adamson* 2351 (BOL); *Galpin* 12448 (K, PRE); *L. Bolus* (CT); Klaver Valley *Moss* 7506 (BM, J), 7507 (BM, J); *Salter* 1944 (BOL, K); *Wall* 860 89 (S); Kommetje *Adamson* 695; Olifantsbosch *Levyns* (CT); Theefontein *Compton* 21839 (KIR); Cirkels Vlei *Barker* 3955 (KIR); *Salter* 1919 (BM, K); Bonteberg *Adamson* 1653, 1654 (CT); Smitswinkel *E. P. Phillips* (PRE); Patrys Vlei *Salter* 5759 (CT); Paulsberg *Adamson* 2407 (CT); *Compton* 13002 (KIR); *Salter* 5733 (CT).

R. ciliata × triflora.

Plants presumed to be this cross are intermediate in the features of the bracts but more like *R. ciliata* in the corolla. Some of the hybrids look like *R. incurva* but have much narrower bracts with stout cilia at the base passing into narrow teeth at the top.

CAPE: Constantiaberg *Compton* 16944 (KIR); Red Hill *Adamson* 689A; Smitswinkel *Adamson* 741, 1597; Patrys Vlei *Salter* 292 22 (BM); Smiths Farm *Adamson* 701 (PRE).

6. **R. Dregeana** A.DC. in DC. Prodr. 7. 446. 1839.

R. leptosepala Sond. Fl. Cap. 3. 593. 1865.

Variable in habit, erect or sprawling, usually slender, with few or many ascending branches. Stems hairy. Leaves short, 3—5 mm. long, ascending or incurved, narrowed from the base to the tip, glabrous above, covered with short hairs below, with distant pinnate teeth, the midrib slightly projecting below. Axillary tufts of small leaves usually present. Flowers solitary or clustered. Bracts numerous, brown and dry, 1—1·5 cm. long, pinnate, narrowed to an acuminate hair-like point, the teeth bristle-like, ascending, 3—6 mm. long. Bracts finely ciliate, covered with very short hairs but glabrescent. Calyx lobes longer than the bracts, almost as long as the corolla, linear-lanceolate, narrowed to a hair-like point, with few or many bristle-like lateral teeth. Calyx covered with very short hairs, at least when young. Corolla pale blue or white, concolorous, 1—1·5 cm. long, the lobes about as long as the tube.

Mostly among rocks on the upper parts of the Worcester-Wellington mountains and on ranges extending eastwards. Rare below 3,000 ft.

The type is *Drège* (*R. ciliata* Thb.) in herb DC., Geneva.

Plants from high altitudes are small and often almost prostrate, those from lower levels or sheltered spots are larger and erect. Blue and white flowered forms occur in definite groups.

There is no doubt that *R. leptosepala* Sond. is this species; it was founded on *Drège* (*R. ciliata* Thb.) in herb. Sonder, Stockholm. DeCandolle's plant was collected on Paarlberg, Sonder's in Du Toit's Kloof, but the two are identical.

WORCESTER: Observation Peak *Esterhuysen* 8624 (BOL); Slanghoek Peak *Adamson* 3739; Du Toit's Kloof *Drège* (S). PAARL: Paarlberg *Drège* (BM, G, K, OXF, P); Wellington Sneeuwkop *Adamson* 3636; Bains Kloof *Adamson* 3569 (CT); *Bolus* 4060 (BOL); *Schlechter* 9179 (BM, BOL, G, K, P, PRE, S). CALEDON: Viljoens Pass *Burchell* 8144 (K); Swartberg *Zeyher* (S). ROBERTSON: Sondereinde Mts. *Adamson* 4441. WITHOUT LOCALITY: *Harvey* 12116 (BM).

Var. **nitida** Adamson nom. nov.

R. nitida Schlechter Bot. Jahrb. 24. 446. 1898.

Differs in the more slender erect habit; the very short leaves; the flowers usually in groups; the very short brown bracts, 4—5 mm. long, with straight spreading close teeth and acuminate but not hair-like tip; and the corolla much longer than the narrowly acuminate calyx lobes.

Mountain slopes between 2,000 and 3,000 ft. Rare and local.

The type is *Schlechter* 7483 in herb Berlin.

Tulbagh: Nr. Tulbagh *Schlechter* 7483 (BM, BOL, GRA, K); Baileys Peak *Stokoe* (CTM).

7. **R. psammophila** Schlechter Bot. Jahrb. 24. 446. 1898.

Small branched more or less erect shrublets rarely over 20 cm. high, the branches ascending. Stems hairy. Leaves 5—9 mm. long, very narrow, very acute, usually glabrous but ciliate at the base, usually with remote hair-like pinnate teeth in the upper part. Fascicles of small leaves usually present in the axils. Flowers solitary or in groups of 2 or 3. Bracts lax, brown, long and very narrow, 1—1·3 cm. long, closely ciliate, usually glabrous on the back, hair-pointed, with few remote lateral pinnate teeth. Calyx lobes not longer than the bracts, glabrescent, closely ciliate, acuminate, entire or with 1 or 2 pairs of pinnate teeth. Corolla white, concolorous, 1—1·3 cm. long, not or very little longer than the calyx, the lobes shorter than the tube. Ovary minutely hairy.

Mountain slopes near the coast.

The type is *Schlechter* 7436 in herb Berlin.

Caledon: Houwhoek *Schlechter* 7436 (BM, BOL, CTM, K, P, PRE); Onrust *Esterhuysen* 5019 (KIR); Hermanus *Gillett* 571 (BOL); Paardeberg *Adamson* 4189, 4193, 4194, 4198; *Levyns* 8798 (CT); Kogelberg *Compton* 19408 (KIR); Genadendal *Schlechter* 9858 (GRA, p. pte). Without Locality: *Waldegrave* (BM).

R. incurva × psammophila.

Presumed hybrids have been found where the two species are associated. These are more like *R. incurva* in size and in the calyx, but the bracts are intermediate and show a range from one species to the other. The corolla is usually blue.

Caledon: Paardeberg *Adamson* 4191, 4192, 4195, 4196, 4202.

The three species, *R. triflora, R. Dregeana* and *R. psammophila,* are closely related and in several of their features seem to form a series. As they occupy geographical areas which do not overlap they are treated as distinct species. They appear to be derivatives from a common ancestor which have diverged in isolation.

8. **R. Dunantii** A.DC. Monog. Camp. 175. 1830.

R. minor Buek in E. & Z. Enum. 385. 1837 (p. pte.). *R. gracilis* Buek. l.c. (p. pte.). *R. reticulata* var. *Dunantii* Sond. Fl. Cap. 3. 592. 1865 (p. pte.).

A small low-growing often prostrate plant with much branched stems, the branches erect or prostrate. Stems rarely over 25 cm. long, the younger hairy and with crowded squarrose leaves. Leaves 4—7 mm. long, linear, flat, glabrous except for stout cilia near the base, soon deciduous but with axillary tufts of small leaves. Flowers aggregated or solitary. Bracts numerous, broader than the leaves, flat or obtusely bulged below, densely ciliate with stout white hairs. Calyx lobes 5—8 mm. long, flat, glabrous externally, densely hairy inside, ciliate at the base, often with 1 or 2 pairs of pinnate teeth near the tip. Corolla 0·7—1 cm. long, pale blue or white, usually concolorous but occasionally with small blue dots on the lobes, the lobes as long as or longer than the tube. Disc flat. Ovary hairy.

Sheltered places on flats or lower mountain slopes in the south-west. Rather rare.

The type is *Ecklon* (s.n. herb. Dunant) in herb. DC. Geneva.

Appears to flower most freely after fires. A species that has been much confused. Specimens have been referred to *R. ciliata*, *R. prostrata* and others. While similar in general form and in flower size to the Series *Prostratae*, the features of the bracts indicate affinity with Series *Ciliatae*. Both *R. minor* and *R. gracilis* are largely this species but include others also.

CAPE: Cape Town *Ecklon* (G). CALEDON: Sir Lowry Pass *Adamson* 4037, 4044; *Schlechter* 7282 (BM, GRA); Steenbras *Salter* 4217 (BM, K); Caledon Baths *MacOwan* 3013 (CTM); Swartberg *Liebenberg* (S); Caledon *Ecklon & Zeyher* 4 (S); Genadendal *Schlechter* 9858 (BM, BOL, G, GRA, P). STELLENBOSCH: *Marloth* 10009 (PRE). WITHOUT LOCALITY: *Ecklon & Zeyher* 2405 (G); *Zeyher* (S).

A specimen from "Salt River" (G) without collector's name is this species.

Series 2. PROSTRATAE.

Suffruticosae, saepissime prostratae. Folia linearia. Flores solitarii bracteis foliis similibus circumdati. Calycis lobi vix amplificentes. Corolla concolor, 1·5 cm. vel minus longa.

Shrublets most commonly prostrate. Stems hairy. Leaves linear, often without axillary fascicles. Flowers solitary. Bracts like the leaves but usually more crowded and often more toothed. Calyx lobes not or very little enlarged at the fruiting stage. Corolla concolorous, rarely over 1·5 cm. long.

KEY TO THE SPECIES.

1. Leaves flat, rigidly squarrose, without axillary fascicles: plants erect.
    2. Lower leaves reflexed: calyx lobes acute, toothed, reflexed at the tip .. .. 13. *recurvata*

2. Leaves not reflexed: calyx lobes 3-fid at the tip, not reflexed .. .. 14. *Goodiana*

1. Leaves linear or linear-subulate, not rigidly squarrose: often with axillary fascicles.

3. Calyx lobes broad, densely hispid with short hairs 12. *latiloba*

3. Calyx lobes linear or linear-lanceolate, either glabrous or covered with very short hairs.

4. Bracts squarrose or reflexed: calyx lobes densely covered with very short hairs .. .. .. 11. *arenaria*

4. Bracts not squarrose nor reflexed: calyx lobes glabrous outside.

5. Bracts and calyx lobes rigid, toothed: leaves short, often reflexed .. .. .. 10. *bryoides*

5. Bracts and calyx lobes not rigid: leaves at least 0·5 cm. long, not reflexed .. .. 9. *prostrata*

9. **R. prostrata** E. Mey. ex A.DC. in DC. Prodr. 7. 447. 1839.

R. reticulata A.DC. Monog. Camp. 174. 1830 *non* L. (cf. J. S. Af. Bot. 12. 107. 1946). *R. Dunantii* auct. *non* A.DC. (e.g. Adamson in Adamson & Salter Fl. Cape Pen. 743. 1950). *R. gracilis* Buek in Eckl. & Zeyh. Enum. 385. 1837 (p. pte.).

Stems woody, prostrate, ascending or erect, branched. Leaves usually crowded, erect or squarrose, often secund. linear or linear-subulate, 0·5—1 cm. long, glabrous except for stout setose hairs near the base, the midrib broad and bulging below. Leaves persistent for more than one year, in the later stages with axillary fascicles of small leaves. Flowers solitary, often on short branches. Bracts like the leaves but usually more crowded, more strongly ciliate, and sometimes toothed. Calyx lobes flat, 5—8 mm. long, linear-lanceolate, entire or with lateral teeth, glabrous or hairy on the back, on the inside hairy all over, on the middle line only, or glabrous. Corolla white or pale blue, concolorous, 0·8—1·3 cm. long, often hairy outside, the lobes acute, spreading, longer than the tube, the calyx lobes longer than the tube. Anthers longer than the filaments. Style hairy, bulged below the stigma. Ovary hairy.

Flats and lowest slopes in the extreme south-west.

The type of *R. reticulata* A.DC. is *Vahl* in herb DC., Geneva; of *R. prostrata*, *Drège* in herb DC. The two are conspecific.

Variable in size and habit. Examination of a large number of specimens has shown that it is not possible to segregate the forms satisfactorily. Such features as the number of bracts, the relative length of calyx and corolla, the presence or absence of hairs on the calyx and corolla, are variable without obvious correlation. Every gradation between extremes can be found.

MALMESBURY: Darling *Wallich* (BM, S); Hopefield *L. Bolus* (BOL). CAPE: Klipheuvel *Pappe* (CTM); Tygerberg *Drège* (S); Vygeskraal *Wolley-Dod* 687 (BM, K); Doornhoogte *Ecklon & Zeyher* 2406 (CTM, p. pte.); *Zeyher* 3417 (CTM, P); Koeberg *Pillans* (BOL, GRA); Cape Flats *Ecklon* (S), 283 (S); *Ecklon & Zeyher* (CTM); *MacOwan* 3059 (G); *Zeyher* (CTM); Cape Town *Bolus* (BOL), 3291 (GRA); *de Castelnau* 371 (P); *Rogers* (BM); Rondebosch *Adamson* 2769, 4455; *Bolus* 78 (BM, CTM, G, K, P), 2268 (K), 3291 (CTM); *Galpin* 12722 (K, PRE); *MacOwan* 78 (K); *Wolley-Dod* 2208 (K); Claremont *Schlechter* 302 (BM, CGE, P); Kenilworth *Adamson* 2774; Bergvliet *Marloth* 8410 (PRE); Retreat *Salter* 4274 (BOL); Princess Vlei *MacOwan* 78 (GRA), 3059 (CTM, GRA), 3291 (GRA); Tokai *Levyns* 5511 (CT); *Salter* 292/13 (K); Steenberg *Adamson* 3487; *Salter* 2956 (BOL); Muizenberg *Guthrie* 304 (CT); Fish Hoek *Moss* 18992 (BM); Kommetje *Adamson* 855; *Moss* 9837 (J); Slangkop *Hafstrom* (S); Witsands *Acock* 3956 (S); Camel Rock *Wall* 3138 (S); Theeberg *Lèvyns* (CT); Theefontein *Compton* 17921 (KIR); Schusters River *Adamson* 693; Cirkels Vlei *Galpin* 12299 (K, PRE); Smitswinkel *Adamson* 1726; *Barker* 3949 (KIR); *Compton* 16940 (KIR); *Moss* 5057 (BM, J); *Salter* 292/13 (BM); Platboom *Adamson* 522; Vasco da Gama Peak *Adamson* 2456. STELLENBOSCH: Bottelary *Acock* 2316 (S); Stellenbosch *Ecklon & Zeyher* 2409 (CTM); Simonsberg *Drège* (G.). PAARL: Paarl *Hafstrom* (S). CALEDON: Steenbras River *Salter* 4217 (BOL); Villiersdorp *Schlechter* 9905 (G, K, P). WITHOUT LOCALITY: *Banks & Solander* (BM); *Bonpland* (P); *Masson* (BM); *Mund* (K); *Ryder* (K); *Vahl* (G); *Verreaux* (G); *Wallich* (K).

One specimen on the sheet *Ecklon & Zeyher* 2408 (CTM) is this species. The locality given, Gamtoos River, seems unlikely.

A single specimen from Huis River, Ladismith (*Lewis* (CTM)) is apparently an undescribed plant allied to *R. prostrata*. It differs in the depressed habit; scattered leaves; solitary flowers with few, 5—8 bracts which are flat, ciliate below and toothed above. The outer bracts may have axillary fascicles of leaves. The material is insufficient for diagnosis.

R. ciliata × prostrata.

Plants presumed to be this hybrid have the general habit of *R. prostrata*, but have numerous often very narrow strongly ciliate bracts, and a rather large corolla often with a dark band at the base of the lobes.

CAPE: Kraaifontein *Salter* 6492 (K), sn (BOL); Melkbosch *Wasserfall* 776 (KIR).

10. **R. bryoides** Buek in Ecklon & Zeyher Enum. 386. 1837.

R. minor Buek l.c. (p. pte). *R. gracilis* Buek l.c. (p. pte).

A slender erect or sprawling woody shrublet, 25—40 cm. high, with ascending branches. Stems ridged, coarsely hairy. Leaves short, 3—6 mm. long, usually squarrose, the older reflexed, ciliate at the base, usually with axillary fascicles of smaller leaves. Flowers solitary, most often on short branches. Bracts leaf-like but rigid, more strongly ciliate, keeled below, toothed at the top. Calyx lobes rigid, flat, usually glabrous, 6—7 mm. long, acuminate, with a pair of almost pungent teeth near the tip. Corolla white or pale blue, 0·8—1 cm. long, the lobes about as long as the tube. Ovary hairy.

Dry bushy places on lower mountain slopes along the west coast.

The type is *Zeyher* 1082 in herb Berlin.

Apparently rare. Allied to *R. prostrata* and much confused with it. Distinguished by the short leaves, the rigid toothed bracts and calyx lobes.

Namaqualand: Kamiesberg *Zeyher* 1082 (BM, G, K, OXF, S); *Zeyher* (S). Cape: Klipheuvel *Pappe* (CTM); *Zeyher* 1082 (CTM). Caledon: Villiersdorp *Schlechter* 9905 (BM, GRA, PRE); Swartberg *Ecklon & Zeyher* 2407 (CTM, p. pte). Without Locality: *Ecklon & Zeyher* 2406 (CTM, p. pte).

The unlocalized specimens, *Ecklon & Zeyher* 2407 (BOL) and 2411 (CTM), are probably this species but are without flowers.

11. **R. arenaria** Schlechter Bot. Jahrb. 27. 193. 1900.

Stems decumbent, prostrate or sprawling, up to 40 cm. long, branched mostly from the base. Leaves crowded, fasciculate, linear, ciliate, 0·5—1 cm. long, often with a few lateral teeth. Flowers solitary. Bracts crowded, squarrose or the lower reflexed, more rigid than the leaves and more toothed. Calyx densely covered with very short hairs, the lobes 0·6—1 cm. long, 2—2·5 mm. wide, flat, acute, with coarse pinnate teeth. Corolla white, 1—1·5 cm. long, the acute lobes longer than the tube, the tube shorter than the calyx. Ovary hairy.

Sandy soils on low hills and flats near the south coast.

The type is *Schlechter* 9691 in herb Berlin.

Very close to *R. bryoides* and possibly not really distinct. It differs in the larger leaves; squarrose or reflexed bracts; hairy calyx, and more deeply lobed corolla. As the two have distinct habitats and are geographically separate, it is convenient to keep them apart.

Caledon: Danger Point *Compton* 10264 (KIR); Palmiet River *Zeyher* 2409 (CTM). Bredasdorp: Rietfontein Poort *Bolus* 8750 (BOL, K, p. pte), 8752 (PRE); *Schlechter* 9691 (BM, BOL, G, K), 10593 (BM, BOL, GRA). Without Locality: *Wallich* (G).

12. **R. latiloba** A.DC. in DC. Prodr. 7. 447. 1839.

A shrublet 15—30 cm. high, erect, with ascending branches. Leaves 4—5 mm. long, usually squarrose, linear, ciliate near the base. Flowers solitary. Bracts few, like the leaves but with linear pinnate teeth. Calyx longer than the bracts, the lobes broadly triangular, 6—7 mm. long, 3—4 mm. wide, acute, externally densely covered with short stout hairs, hairy inside, the edges slightly revolute near the top, usually with 1—2 teeth lower down. Corolla pale blue or white, concolorous, 1—1·5 cm. long, the lobes twice as long as the tube.

Rare and apparently discontinuous. On low hills.

The type is *Drège* 6322 in herb DC., Geneva.

A very distinctive species but seldom collected.

Clanwilliam: Zwartbastkraal *Drège* 6322 (K, OXF, P, G, S). Bredasdorp: Brandfontein *C. A. Smith* 5033 (PRE).

The Bredasdorp plants have narrower and more acute calyx lobes than *Drège's* specimens.

13. **R. recurvata** A.DC. in DC. Prodr. 7. 447. 1839.

A small erect shrublet, branched especially from the base, 10—25 cm. high. Stems usually glabrous. Leaves crowded, squarrose or the lower reflexed, flat, rigid, 3—4 mm. long, acute, remotely ciliate, slightly decurrent. Flowers usually solitary, terminal, surrounded by numerous bracts like the leaves but slightly wider, more crowded, and squarrose-recurved, the innermost with narrow teeth near the tip. Calyx lobes lanceolate, flat, acute, 4 mm. long, toothed near the tip, the tip and teeth recurved. Corolla campanulate, blue or white, 1—1·5 cm. long, the lobes shorter than the tube. Ovary minutely hairy.

Endemic on sandy soils at low levels in the southern part of the Cape Peninsula.

The type is *Drège* 6323 in herb. DC., Geneva.

Cape: Muizenberg *Galpin* 12555 (PRE, p. pte); *Levyns* (CT); Steenberg *Adamson* 3496; *Levyns* 5617 (CT); Kalk Bay Mts. *Potts* (CTM); Red Hill *L. Bolus* (CT), 14273 (BOL); Olifantsbosch *Galpin* 12723 (K, p. pte, PRE); *Salter* 4263 (BOL); Klaasjagers *Levyns* (CT); Smitswinkel *Salter* 292/16 (BM, K); Rooihoogte *Adamson* 3156; Patrys Vlei *Compton* 19368 (KIR); Paulsberg *Adamson* 1722, 2469; *Salter* 5826 (BM, K); Cape Point *Adamson* 2768; *Michell* (CT); *Schlechter* 7321 (BM, G, GRA, K). Without Locality: *Drège* 6323 (G, S), sn (G); *Sir F. Gray* (P).

14. **R. Goodiana** Adamson J. S. Afr. Bot. 5. 55. 1939.

R. ericoides Good J. Bot. 62. 48. 1924. *non* Spreng. *nec* Buek.

Much like *R. recurvata* but softer, less branched and a paler green.

Leaves flat, acute, 4—6 mm. long, squarrose-spreading or ascending, not reflexed even when old. Bracts not recurved, like the leaves. Calyx lobes flat, often red, 4—6 mm. long, acute, 3-toothed at the tip, the tip and teeth erect. Corolla, white, rarely over 1 cm. long.

A local endemic confined to a small area in the Klaver Valley near Simonstown.

The type is *Moss* 7508 in herb. B.M.

Closely allied to *R. recurvata* but distinguished by the longer, more spreading, pale green, not recurved leaves; the regularly 3-toothed calyx lobes; and the small white corolla.

CAPE: Klaver Valley *Adamson* 183 (PRE), 823 (CT, PRE); *Levyns* 5133 (CT); *Moss* 7508 (BM, J, PRE); *Salter* 292 17A (BM), 1943 (BM, K), 5801 (CTM, K).

Series 3. SPICATAE.

Folia linearia non decurrentia. Flores in capitulis 1—5 floriferis dispositi, bracteis latis saepissime dentatis circumdati.

Shrublets. Leaves linear, not decurrent, usually with axillary fascicles of smaller leaves. Flowers in heads with 1—5 flowers, surrounded by broad-based, almost clasping bracts usually toothed at the top. Corolla rarely over 1·5 cm. long.

KEY TO THE SPECIES.

1. Outer bracts leaf-like but broad-based: calyx lobes densely hairy: corolla with spreading lobes: style longer than the corolla .. .. 15. *lightfootioides*

1. Outer bracts not leaf-like: corolla tubular or campanulate: style not as long as the corolla.

  2. Flower heads 1·5 cm. or more long and wide: leaves over 1 cm. long.

    3. Leaves crowded, rigid, squarrose: bracts folded, 5-toothed .. .. 16. *compacta*

    3. Leaves scattered, soft: bracts not folded.

      4. Erect: flower heads 2 cm. long: bracts glabrous, toothed or lobed at the top .. 17. *glomerata*

      4. Prostrate: flower heads not over 1 cm. long: bracts ciliate, orbicular, cuspidate 20. *cuspidata*

  2. Flower heads less than 1 cm. long: leaves usually less than 1 cm. long.

    5. Flower heads few-flowered, aggregated: bracts longer than wide, acuminate .. 18. *spicata*

    5. Flower heads compact, often solitary: bracts as wide as long.

6. Bracts truncate, 5—7-toothed, the teeth squarrose or recurved: corolla less than 1 cm. long .. .. 19. *secunda*
6. Bracts orbicular-cuspidate, the outer entire, the inner toothed: corolla at least 1 cm. long .. .. 20. *cuspidata*

15. **R. lightfootioides** Schlechter Bot. Jahrb. 24. 482. 1898.

A small prostrate or semi-erect woody plant, 4—15 cm. high with many erect branches. Young stems hairy. Leaves crowded, linear, 5—6 mm. long, coarsely ciliate, acute or almost mucronate, the midrib rather bulging below. Flowers in loose terminal heads with 1—4 flowers, most commonly 2 or 3. Bracts widened at the base, glabrous but ciliate and often with some hairs on the midrib, the outer like the leaves but with a sheath 2 mm. long and wide, the inner clasping, with a narrow point 3 mm. long, and smaller lateral teeth. Calyx lobes longer than the bracts, lanceolate-acuminate, 1·5—2 mm. wide, densely covered with very short hairs. Corolla white, 0·7—0·8 cm. long, twice as long as the calyx lobes, with spreading rather narrow lobes twice or more times as long as the tube. Style as long as or longer than the corolla. Ovary hairy.

Confined to sandy soils on lower mountain slopes in the Caledon Division.

The type is *Schlechter* 7397 in herb. Berlin.

Apparently rare. In the features of the bracts the species forms a transition between the Series *Prostratae* and *Spicatae*.

CALEDON: Houwhoek *Schlechter* 7397 (BM, BOL, CTM, G, GRA, K, P, PRE, S); Caledon *Purcell* (CTM).

16. **R. compacta** Schlechter Bot. Jahrb. 27. 193. 1900.

Stems woody, prostrate with ascending tips, branched mostly from the base, 10—30 cm. long. Young stems densely hairy, almost completely hidden by the crowded squarrose leaves and axillary fascicles of smaller leaves. Leaves 4—9 mm. long, 1—4 mm. wide, strongly revolute, acute or almost pungent, entire or with 1—2 pairs of lateral teeth, the margins and sometimes the underside with stout setose hairs. Flowers in terminal heads, 1·5—3 cm. across. Bracts much broader than the leaves, coarsely ciliate, with strongly revolute margins, the outermost pinnately toothed, the inner folded round the flower, with 5 almost equal teeth. Bracts often hispid on the back. Calyx lobes longer than the bracts, 3—7 mm. long, lanceolate, acuminate, glabrous. Corolla pale blue or white, yellowish on fading, about 1 cm. long, campanulate, the lobes as long as the tube. Style slightly thickened below the stigma. Ovary glabrous.

Confined to limestone or sand over limestone near the coast in the extreme south-west.

The type is *Schlechter* 9714 in herb. Berlin.

CAPE: Nr. Buffels Bay *Adamson* 2461A (BOL, CT, CTM); *Levyns* (CTM); *Lewis* (CTM); *Salter* 292/14 (BM, BOL, K), 8008 (BOL, KIR, PRE). BREDASDORP: Ratel River *Bolus* 8572 (BOL, K); *Schlechter* 9714 (BM, BOL, G, K, P, PRE, S); Cape Agulhas *Pillans* 2543, 8157 (BOL); *Salter* 4112 (BM, K); *L. E. Taylor* 1586 (GRA, PRE); Hagekraal River *Compton* 19031 (KIR); *Leighton* 2543 (BOL); Baardscheerdersbosch *Barker* 5293 (KIR).

N.B.—In several cases the sheets of the type number (*Schlechter* 9714) contain portions of other plants.

17. **R. glomerata** A.DC. in DC. Prodr. 7. 444. 1839.

Stems up to 50 cm. high, glabrous, ridged, woody below, erect, branched mostly from the base. Leaves numerous but not crowded, 0·5—1·5 cm. long, 2—4 mm. wide, soft, flat, spreading or ascending, entire or with occasional teeth, ciliate at the extreme base otherwise glabrous, with or without axillary fascicles of small leaves. Flowers in dense heads, on the main stem and on long or short lateral branches, many-flowered, 1·5—3 cm. long and about as wide. Bracts broad, clasping, glabrous, acutely 3—7-toothed or lobed at the top, slightly thickened at the edges, the outer with the central lobe longer than the others, the inner with almost equal teeth. Calyx lobes longer than the bracts, glabrous, acute or acuminate, about half as long as the corolla. Corolla white, pale blue, mauve or pinkish, 1—2 cm. long, the lobes longer than the tube. Ovary glabrous.

Grassy places at low altitudes in the eastern districts. Most often on sand and near the coast.

The type is *Drège* 4011 in herb. DC., Geneva.

The largest species and the only one that extends beyond the limits of the sclerophyll vegetation.

CAPE: East London *Barker* 1289 (KIR); *Galpin* 3129 (PRE); *Potts* 1795 (BOL); *C. A. Smith* 3829 (PRE); Bonza Bay *Acock* 9550 (PRE); Overton *Hilner* 280 (PRE); Kei Mouth *Flanagan* 460 (CTM, GRA, PRE); Omsamcaba *Drège* 4011 (BM, G, K, OXF, P, S); *MacOwan* 1633 (G). NATAL: Port Shepstone *Weeks* 87*bis* (J); *Wood* 397 (PRE); Durban *Harvey* (BM); *Wood* 233 (BM, BOL, GRA, K, CTM), 7504 (P), sn (GRA); Clairmont *Gerrard & McKen* 872 (S); *Schlechter* 2833 (GRA); *Wood* 1003 (PRE), 1033 (BM, BOL, CTM, G, K, P, PRE), 5524 (PRE); Zululand *Gerrard* 393 (BM, K), 623 (BM), 1502 (BM); Uvongo *Acock* 10906 (PRE).

18. **R. spicata** L.f. Supp. Pl. 143. 1781.

R. bracteata A.DC. Monog. Camp. 179. 1830. *Campanula bracteata* Thunb. Phyto. Bl. 30. 1797: Fl. Cap. ed Schultz 171. 1823. *R. Eckloniana* Buek in E. & Z. Enum. 385. 1837. *R. ericoides* Buek l.c. *R. campestris* A.DC. in DC. Prodr. 7. 447. 1839.

An erect or diffuse ericoid shrublet up to 40 cm. high, usually with many ascending branches. Stems hairy. Leaves usually crowded, spreading or ascending, linear, 3—7 mm. long, flat above, obtusely keeled below, more or less trigonous, glabrous but most often coarsely ciliate near the base, sometimes covered with short hairs, most often with axillary fascicles of small leaves. Flowers in terminal and lateral heads, usually crowded in a spike-like inflorescence. Heads longer than wide, 4—8 mm. long, 3—6 mm. wide, each with 1 or less often 2 or 3 flowers. Bracts glabrous or covered with short hairs, 4—8 mm. long, broad-based, ovate in outline, acute or more often acuminate, with a narrow point 2—3 mm. long; the outer entire or with a few teeth, the inner with few or many teeth. Calyx longer than the bracts, the lobes lanceolate, acute, 3—5 mm. long. Corolla white, tubular-campanulate, 0·6—1·3 cm. long, the lobes as long as or longer than the tube. Filaments ciliate at the base. Style hairy. Ovary hairy.

Mountain slopes usually among rocks on the ranges along the south coast from Caledon to Port Elizabeth.

The type is in herb. Thunberg, Uppsala.

Possibly a composite species. Variable in habit, leaf-length and in the shape of the bracts. The bracts range from ovate to truncate-acuminate, and from many to few toothed, with the teeth long or short. The point of the bract may be erect or bent outwards. Several of the variations have been given specific rank but the distinctions are not sharp and intermediate forms occur. Pending detailed field investigation, they are all grouped under one species for convenience.

Caledon: Genadendal *Burchell* 7923 (K), 7986 (K). Bredasdorp: Elim *Compton* 5289 (KIR). Swellendam: Zuurbraak *Thode* A2346, A2347 (PRE). Riversdale: Riversdale *Schlechter* 1758 (BOL, J); Langeberg *Hafstrom & Acock* 2010 (PRE); Garcias Pass *Adamson* 4365, 4371, 4374; *Wall* 2475, 2485, 2491 (S). Prince Albert: Swartberg Pass *Adamson* 4352, 4363; *Wall* 439/30 (S); *Zeyher* 2410 (CTM). Mossel Bay: Reutersbosch *Salter* 3245 (BOL). George: Camfer Stn. *Esterhuysen* 16791 (BOL). Uniondale: Avontuur *Fourcade* 2073 (BOL), 2486 (BOL, PRE); *Esterhuysen* 16777 (BOL); Ongelegen *Bond* 922 (KIR); *Esterhuysen* 4693 (BOL). Humansdorp: Wit Els Bosch *Fourcade* 2073 (PRE); Jeffreys Bay *Fourcade* 5910 (KIR), 5917 (BOL). Uitenhage: Gamtoos River *Ecklon & Zeyher* 2408 (CTM, p. pte, S); Van Stadens River *Burchell*

4645 (K); *Zeyher* 2414 (CTM); Bethelsdorp *Drège* 6321 (BM, G, K, OXF, P, S). PORT ELIZABETH: Parsons Vlei *F. R. Long* 497, 926 (K, PRE). CATHCART: Cathcart *Moss* 15325 (J). WITHOUT LOCALITY: *Harvey* (K), 1153 (BM); *Montini* (S); *Prior* (K); *Verreaux* (G); *Zeyher* 3417 (S).

Var. **Burchellii** Adamson var. nov.

Folia laxa distantia. Capitula laxa. Bracteae paucidentatae acumine longissimo. Calycis lobi corollae aequilongi.

Sprawling, subherbaceous or woody at the base only. Leaves distant, soft, 0·5 cm. long, concave above, coarsely ciliate. Heads lax, the bracts scarcely clasping. Bracts with a very long point with 1—2 very short teeth at its base. Calyx lobes 0·5—0·7 cm. long, about as long as the corolla.

The type is *Burchell* 6849 in herb Kew.

RIVERSDALE: Klein Vette River *Burchell* 6849 (K, P).

19. **R. secunda** Buek in E. & Z. Enum. 386. 1837.

Prostrate, sprawling or occasionally erect shrublets with many short, often secund branches. Stems hairy, up to 50 cm. long, the branches 5—8 cm. Leaves glabrous or shortly hairy, crowded, more or less squarrose, flat, 3—7 mm. long, ciliate, occasionally toothed, with axillary fascicles. Flower heads terminal, compact, as broad as long, usually 3-flowered, less often 1, 2, or 5, the heads sometimes grouped. Bracts covered with short hairs or rarely glabrous, the outer ovate-acuminate, the inner truncate and 5—7-toothed at the top, the central tooth as long as or longer than the others. Teeth on the bracts squarrose or recurved in the later stages. Calyx lobes 3—5 mm. long, longer than the bracts, lanceolate, acute, the tips bent outwards. Corolla white, tubular, 4—8 mm. long, the lobes about as long as the tube. Style hairy, as long as the corolla, stigma lobes truncate. Disc concave, yellow. Ovary very shortly hairy.

Dry sandy or stony slopes at low elevations along the south coast.

The type is *Zeyher* 3150 in herb Berlin.

Somewhat variable in habit. Distinguished by the small compact heads, truncate toothed bracts and small flowers. Specimens in herbaria have been labelled *R. glauca* or *R. prostrata* (E. & Z. *non* A.DC.).

SWELLENDAM: Potteberg *Adamson* 3902, 3918; *David* (KIR). MONTAGU: Baths *Bolus* 7881 (BOL, K), 2763 (KIR). RIVERSDALE: Riversdale *L. Bolus* (BOL); Still Bay *Muir* 3166 (PRE); Gouritz River *Zeyher* 2415 (BM, CTM, G, OXF, P, S). OUDTSHOORN: Oudtshoorn *Bolus* 12102 (BM, BOL, K). KNYSNA: Knysna *Wall* (S). GEORGE: Meulen Riv. *Moss* 21338 (J). UNIONDALE: Prince Alfreds Pass *Zinn*

(CTM); Long Kloof *de Castelnau* 294 (P). UITENHAGE: Van Stadens River *Burchell* 4481 (K, P); Bethelsdorp *Zeyher* 3150 (CTM, G, K); Swartkops River *Drège* (P); *Zeyher* 3151 (CTM, G); Uitenhage *Zeyher* 447 (CTM). WITHOUT LOCALITY: *Ecklon & Zeyher* (CGE), 2414 (BM, CTM, G, OXF, P); *Harvey* (K).

A specimen collected by *Zeyher* (BOL) is labelled "Kamiesberg". The label is not original and the locality seems unlikely.

20. **R. cuspidata** Adamson sp. nov.

Caules prostrati hirsuti pauciramosi. Folia laxa fasciculata plano-convexa, basi ciliata. Flores in capitulis densis aggregati, capitulis solitariis vel spicatis, saepissime trifloris. Bracteae latae, dense ciliatae suborbiculares, exteriores acuminato-cuspidatae, interiores apice dentatae. Calycis lobi acuminati bracteis multo longiores. Corollae lobi tubo longiores vel aequilongi.

Prostrate with many not much branched stems from a woody base. Stems 15—50 cm. long, the younger ridged, hispid. Leaves scattered, not crowded, spreading, often secund, plano-convex, 0·7—1·5 cm. long, glabrous or coarsely ciliate in the lower half, usually with axillary fascicles. Flower heads compact, often wider than long, 0·6—0·8 cm. long, 0·7—1·2 cm. wide, solitary or in close spicate groups, each with 1—5, most commonly 3 flowers. Bracts usually glabrous but edged with dense short close cilia, more or less orbicular, the outer entire, cuspidately acuminate, the inner toothed at the top with the central tooth longer than the others. Teeth on the bracts often bent outwards in the later stages. Calyx lobes up to 1 cm. long, much longer than the bracts, lanceolate-acuminate, in the bud concave at the back with the edges projecting. Corolla campanulate, white or pale blue, 1—1·5 cm. long, divided half way or more. Style hairy, about as long as the corolla. Ovary glabrous or very minutely hairy.

Lower mountain slopes on open clay or gravel soils in the Caledon-Bredasdorp region.

The type is *Adamson* 4452 in herb Bolus.

CALEDON: Houwhoek *Adamson* 4421; *Guthrie* 4956 (BOL); *Schlechter* 7401 (BM, BOL, G, GRA, K, P, PRE, S); Shaws Mt. *Adamson* 4452; *Barker* 7195 (KIR); Genadendal *Bolus* 6949 (BOL). BREDASDORP: Elim *Bolus* 8571 (BOL, KIR, PRE); Bredasdorp *Galpin* 11245 (K, PRE), 11245a (K); *Guthrie* 4480 (KIR). WITHOUT LOCALITY: *Bolus* 9235 (BOL, K).

Var. **hispida** Adamson var. nov.

A typo differt foliis hispidis plus minusve revolutis; capitulis majoribus trifloris; bracteis hispidis ovato-lanceolatis, acutis, lancerato-serratis.

Differs in the leaves being more or less revolute and hispid; the heads larger with 3 or more flowers; the bracts hispid, ovate-lanceolate, acute, 0·5—0·7 cm. long, the margins more or less deeply lacerate-serrate; and the calyx lobes acute, 0·5 cm. long.

The type is Compton 20997 in herb. Bolus.

BREDASDORP: The Poort *Compton* 20997 (BOL, KIR).

Series 4. SQUARROSAE.

Suffruticosae. Folia ovata, decurrentia, non fasciculata. Flores capitati, capitulis bracteis latis circumdatis.

Erect or sprawling plants with more or less woody stems. Leaves scattered or crowded, ovate, toothed, more or less decurrent at the base, without axillary fascicles. Flowers in heads surrounded by broad often clasping bracts. Corolla campanulate.

Like the Series *Spicatae* but with broader decurrent leaves. All the species confined to the Cape Peninsula.

KEY TO THE SPECIES.

1. Annual: leaves ovate-lanceolate: bracts broadly lanceolate with squarrose tips .. .. .. 21. *decurrens*

1. Perennials: leaves ovate or rounded: bracts rotund-ovate.

  2. Sprawling, slender: leaves with a ciliate decurrent wing: bracts irregularly toothed, not reflexed at the tip .. .. 22. *squarrosa*

  2. Erect, stout: leaves with a glabrous decurrent wing: bracts regularly serrate, the tip reflexed 23. *amplexicaulis*

21. **R. decurrens** L'Hérit. Sert. Ang. 2. t.6. 1784.

R. glabra Poir. Enc. Meth. 6. 252. 1804.

Annual though perennating in shaded situations. Stems erect or sprawling, often rigid and more or less woody, up to 70 cm. high, with many spreading or ascending branches, those at the base often very long. Leaves scattered, ovate-lanceolate or oblong, 0·4—1·2 cm. long, 0·3—0·5 cm. wide, acute, sharply toothed, in open sites rigid and prickly, the bases with short smooth decurrent wings. In shaded plants the leaves are spreading, in open sites falcate-squarrose, with the older reflexed. Flower heads small, terminating all the branches, often 1-flowered but sometimes 2—5. Bracts wider than the leaves and more rigid, 0·7—1·5 cm. long, 0·4—0·7 cm. wide, not clasping, toothed in the upper part, ciliate below, the long acuminate point squarrose. Calyx lobes slightly longer than the bracts, ciliate, acuminate, sometimes subpungent. Corolla 1—1·5 cm. long, pale blue or almost white, funnel-shaped, the lobes almost twice as long as the tube. Ovary glabrous.

On the upper and eastern slopes of Table Mountain.

The type is "Hort. Kew" in herb. B.M.

Variable in size and habit: plants from open and shaded situations may look very different. Flowers only in the open, most freely after fires.

Table Mt. *Bolus* 7966 (BOL); *Compton* (CT), 17377 (BOL, KIR); *Flanagan* 2403 (PRE); Disa Gorge *Esterhuysen* 12630 (KIR); Newlands *Wolley-Dod* 2230 (BM); Window Gorge *Morris* 5 (KIR); Nursery Gorge *Esterhuysen* 1B, 36 (KIR); Kirstenbosch *Adamson* 3494 (CT); *Moss* 1702 (BM), 18993 (BM); *Esterhuysen* 1 (KIR, PRE) sn (PRE); *Kies* 13 (KIR); *Salter* 5773 (BM, BOL, CT, K); Smitswinkel *Compton* 8709 (KIR)?. Without Locality: *Masson* (G). "Hort. Kew" (BM).

22. **R. squarrosa** Berg. Desc. Pl. Cap. 43. 1767.

R. filiformis Lam. Illustr. 11. 66. 1797.

Prostrate or sprawling, occasionally semi-erect. Stems up to 80 cm. long, branched, often very slender, glabrous, slightly woody in the older parts. Leaves usually scattered, sometimes close, ovate, 4—5 mm. long, 2—3 mm. wide, acute, squarrose, often falcate, toothed, ciliate at the base, the decurrent wings ciliate. Flower heads rarely over 1 cm. across, with 1—3 flowers. Bracts rotund-ovate, 4—6 mm. long, 3—4 mm. wide, acute, with rather irregular distant teeth near the top, ciliate at the base. Tips of the bracts squarrose. Calyx lobes not or very slightly longer than the bracts, 3—4 mm. long, acute, usually ciliate. Corolla white with blue veins or tinged with blue, 0·5—1·2 cm. long, the acute lobes as long as the tube. Ovary glabrous.

On the upper parts of the mountains from Table Mt. southwards to Simonstown. Usually among rocks.

Often confused with *R. decurrens*. Distinguished by the shorter broader leaves with ciliate decurrent wings, the more compact heads, the rotund-ovate bracts, and the broader less pointed calyx lobes.

Cape: Table Mt. *Adamson* 1617 (CTM), 1620 (CT), 1642; *Alexander* (K); *Andreae* A251 (PRE); *Bolus* 11426 (GRA); *Ecklon* 696 (OXF, S); *Ecklon & Zeyher* 2412 (CTM); *Esterhuysen* 10034 (BOL, PRE), 11389 (BOL), 12630 (BOL, PRE); *Galpin* 4905 (GRA, PRE); *Gillett* 770 (K); *Harvey* (BM, K); *Hafstrom* (S); *Kensit* 11426 (BOL); *Levyns* (CT); *Mogg* H13686, H13746 (PRE); *Pappe* (CTM); *Stokoe* (CTM); *Wolley-Dod* 806 (BOL), 2230 (BM); *Zeyher* (CTM, S); Nursery Gorge *Compton* 15483 (KIR), 21887 (KIR); Window Gorge *Compton* 8542, 13016 (KIR); Kirstenbosch *Moss & Rogers* 18993 (J); Orange Kloof *Schlechter* 263 (G, P);

Devils Peak *Salter* 292/17B (BM); Twelve Apostles *Wolley-Dod* 2395 (BOL, K); Groot Kop *Esterhuysen* 10034 (BOL); Noordhoek Mts. *Adamson* 2434; *Salter* 1958 (BM, K); Vlaggenberg *Adamson* 1752; Constantiaberg *Compton* 14457 (KIR, PRE); Chapmans Peak *Compton* 8482 (KIR); Steenberg *Wolley-Dod* 808 (BOL); Muizenberg *Bolus* 2980 (CTM. p. pte); *Salter* 5783 (CT); Kalk Bay Mts. *Bolus* 2980 (BM); *Galpin* 12555 (K, PRE); *Salter* 292/19 (BM, K), 2993 (BOL), 2993A (BOL, BM), 4322 (BM, BOL, K, PRE); St. James *Moss* 7558 (BM, J); Swartkop *Adamson* 2473; Klaver Valley *Levyns* (CT). WITHOUT LOCALITY: *Aiton* (G); *Auge* (BM); *Commerson* (G); *Delessert* (G); *Ecklon* (S); *Forsyth* (K); *Harvey* 579 (K); *Grubb* (S); *Lehmann* (P); *Masson* (BM); *Oldenburg* (S); *Poiret* (P); *Richard* (P); *Swartz* (S); *Sonnerat* (P); *Thunberg* (S); *Wahlberg* (S); *Wallich* (CGE); "Hort. Kew" (BM).

23. **R. amplexicaulis** Wolley-Dod J. Bot. 39. 400. 1901 (as *amplexicaule*).

Glabrous. Like *R. squarrosa* but larger, more erect, more rigid, and with larger flower heads. Stems woody, up to 50 cm. high, usually branched from below the flower heads only. Leaves crowded, often overlapping, rotund-ovate, 0·6—1 cm. long, 0·4—0·8 cm. wide, rigid, squarrose, falcate, concave above, clasping at the base, with short smooth decurrent wings. Leaves sharply serrate on the upper part, ciliate on the lower, the tip acute or acuminate and almost pungent. Flower heads 2—4 cm. diam., with 3—8 flowers. Bracts almost orbicular, 0·7—1·3 cm. long, 0·7—0·9 cm. wide, rather regularly serrate on the upper part, ciliate on the lower, the acute tip reflexed. Calyx lobes 5—7 mm. long, scarcely longer than the bracts, 2 mm. wide, acute, ciliate, shorter than the corolla tube. Corolla white or pale blue, 1·2—2·2 cm. long, with broad subacute lobes half as long as the tube. Corolla often hairy inside. Style slightly widened below the stigma. Ovary glabrous.

Endemic to the southern part of the Cape Peninsula. Frequent south of Fish Hoek, less so north to Constantia Nek. Usually among rocks.

The type is *Wolley-Dod* 808 in herb B.M.

Some of the specimens distributed under the type number are not this species but *R. squarrosa*.

CAPE: Hout Bay *Acock* 2848 (S); Steenberg *Wolley-Dod* 808 (BM, K); Muizenberg *Bolus* 2980 (CTM, p.pte); *L. Bolus* (CT); *Guthrie* 1375 (CT); *Schlechter* 598 (P); Kalk Bay Mts. *Adamson* 2402; *Bolus* 2980 (BOL); Silvermine Valley *Compton* 14282 (KIR); Fish Hoek *Hafstrom* (S); Glencairn *Levyns* (CT); Simonstown *MacGillivray* 659 (K); *Miniki* (CTM); *Milne* 154 (K); *Ryder* 153 (K); Red Hill *Adamson* 688 (PRE); *Fairall* 197 (KIR); *Levyns* 5616 (CT); Klaver Valley *Adamson* 827; *Moss* 7491 (BM, J); *Levyns* (CT); *Salter* 292/12A (BM), 5889 (BM, K); Kommetje

Adamson 694; Olifantsbosch *Barker* 4018 (KIR); *Galpin* 12724 (K, PRE); Schusterskraal *Compton* 12998 (KIR); Theefontein *Compton* 21847 (KIR); Bonteberg *Compton* 10624 (KIR); Klaasjagers *Miniki* (CTM); *Salter* 5756 (CT); Hesters Dam *Levyns* (CT); Paulsberg *Adamson* 1678 (BOL), 2468

A specimen (*Moss* 19002 (J)) is labelled "Maritzburg" probably in error.

Series 5. MUSCOSAE.

Subherbaceae, prostratae. Folia vix congesta, non fasciculata, dentata. Flores solitarii, sine bracteis. Corolla parva.

Small usually prostrate almost herbaceous plants. Leaves scattered, toothed, without axillary fascicles. Flowers solitary, without bracts though with 1 or 2 leaves immediately below. Corolla concolorous, not over 1·5 cm. long.

KEY TO THE SPECIES.

1. Leaves glabrous, narrowed to the base .. .. .. 24. *muscosa*
1. Leaves hairy, at least below, with a distinct petiole .. 25. *insizwae*

24. **R. muscosa** L.f. Supp. Pl. 143. 1781.

Low-growing, in flat patches 1 m. or more across, sometimes dense and almost cushion-like. Stems mostly in the ground, woody at the base only, the upper parts slender, much branched, herbaceous, glabrous. Leaves crowded towards the tips of the stems, ovate, 4—6 mm. long, spreading, often falcate, acute, flat, glabrous, the edges with 2—3 serrate indentations ending in a very short seta. Leaves gradually narrowed to a very short petiole sheathing the stem. Flowers solitary, terminal, with 1 or 2 leaves at their base. Calyx lobes lanceolate, acute, 2—3 mm. long, edged with scattered long cilia. Corolla 1—1·5 cm. long, violet-blue with the base of the tube white, campanulate, the spreading or reflexed lobes shorter than the tube. Filaments very shortly flattened at the base. Style about as long as the corolla tube, hairy in the upper part. Disc glabrous, flat at first but becoming hemispherical. Ovary glabrous. Fruit about 4 mm. long, opening by a small pore at the apex of the enlarged disc. Calyx lobes enlarged in fruit and reddish.

On the uppermost parts of mountains in the extreme south-west. Most often on sand among rocks.

The type is in herb. Thunberg, Uppsala.

CAPE: Table Mt. *Acock* 4901 (S); *Adamson* 1627 (CT), 2738, 4454; *Bolus* 3885 (BOL); *Bond* 964 (KIR); *Burchell* 636 (G, K), 639 (P); *Compton* 12939 (KIR), sn (CT); *Drège* 6305 (G, P, S); *Ecklon* (S); *Ecklon & Zeyher* 2413 (CTM); *Hafstrom* (S); *Harvey* (BM); *Goulimis* (BOL);

Levyns (CT); *MacBold* (BOL); *Moss* 7530 (BM); *Oldenburg* (BM); *Schlechter* 164 (GRA, P). STELLENBOSCH: Victoria Peak *Esterhuysen* 14373 (BOL). CALEDON: Kogelberg *Esterhuysen* 9984 (BOL). WITHOUT LOCALITY: *Lindley* (CGE); *Oldenburg* (BM); *Thunberg* (S).

25. **R. insizwae** Zahlbr. Ann. K. K. Hofm. Wien. 18. 401. 1903.

Prostrate herb very much like *R. muscosa* but covered with scattered hairs. Leaves up to 1·4 cm. long, hairy below, rather abruptly narrowed to a petiole. Calyx lobes 7—9 mm. long, oblong-triangular, minutely toothed. Corolla almost white, 1·3—1·5 cm. long.

The type is *Penther* 2759 in herb. Vienna. A somewhat doubtful species of which no specimen has been seen. Only once collected in Griqualand East.

EXCLUDED SPECIES.

R. elegans Paxt. Mag. Bot. 6. 27. 1839.

This is not a *Roella* and almost certainly does not belong to Campanulaceae. It has epipetalous stamens. Though described as having a 2-chambered inferior ovary, the plate suggests a superior one, it might be referable to Gesneraceae.

LIST OF NUMBERED SPECIMENS QUOTED.

Prismatocarpus.

ACOCK. 19 *fruticosus;* 150 *fruticosus;* 2619 *diffusus;* 3820 *sessilis.*

ADAMSON. 457 *fruticosus;* 458, 459 *diffusus;* 470 *diffusus;* 518 *sessilis;* 529 *diffusus;* 819, 821, 822 *sessilis;* 824 *fruticosus;* 1536 *pilosus;* 1568 *pilosus;* 1569 *fruticosus;* 1589 *fruticosus;* 1632 *sessilis;* 1646, 1648 *sessilis;* 1659 *fruticosus;* 1749 *fruticosus;* 2387 *fruticosus;* 2429 *nitidus;* 2435 *fruticosus;* 2460, 2466 *sessilis;* 2781 *fruticosus;* 3105 *fruticosus;* 3137 *diffusus;* 3138 *pilosus;* 3139 *fruticosus;* 3492 *fruticosus;* 3606 *debilis;* 3635 *nitidus* v. *ovatus;* 3877 *lasiophyllus;* 3882 *debilis;* 3883 *lasiophyllus;* 3888 *tenerrimus;* 3895 *sessilis;* 3899, 3900, 3906 *spinosus;* 3908 *campanuloides;* 3922 *diffusus;* 3923 *brevilobus;* 3925 *diffusus;* 4024 *pedunculatus;* 4030 *brevilobus;* 4033 *brevilobus;* 4086, 4089, 4092 *fruticosus;* 4106, 4107, 4108 *pilosus;* 4109 *fruticosus;* 4111 *pilosus;* 4112 *fruticosus;* 4113 *pilosus;* 4114 *fruticosus;* 4117 *pilosus;* 4118 *pilosus;* 4119 *fruticosus;* 4122, 4125 *fruticosus;* 4127 *pilosus;* 4130, 4133 *fruticosus;* 4138 *diffusus;* 4157 *fruticosus;* 4173 *cordifolius;* 4183 *sessilis;* 4190 *tenerrimus;* 4204 *tenerrimus;* 4316, 4318 *campanuloides;* 4330 *fruticosus;* 4336, 4342 *cliffortioides;* 4349 *hispidus;* 4350 *fruticosus;* 4351 *hispidus;* 4366 *tenerrimus;* 4382 *fruticosus;* 4385 *fruticosus;* 4399 *pedunculatus;* 4415, 4416, 4424, 4429 *fruticosus;* 4431 *campanuloides;* 4444 *fruticosus;* 4446 *tenerrimus;* 4448 *campanuloides;* 4453 *nitidus;* 4461 *diffusus.*

ALLEN. 118 *rhodesicus.*

ANDREAE. 191 *fruticosus;* 363 *campanuloides;* 775 *lycopodioides;* 797 *brevilobus;* 810 *Schlechteri.*

BARKER. 476 *diffusus;* 1031 *campanuloides;* 1288, 2177 *campanuloides;* 3959 *sessilis;* 3995 *sessilis;* 4466 *pilosus;* 4467 *fruticosus;* 5262 *campanuloides;* 5284 *spinosus;* 7192 *brevilobus?* × *fruticosus.*

BOLUS. 632 *brevilobus;* 633 *diffusus;* 3051 *campanuloides;* 3289 *sessilis;* 3299 *nitidus;* 4058 *fruticosus;* 4059 *diffusus;* 4161 *diffusus;* 4304 *pedunculatus;* 4653 *fruticosus;* 5103, 5104 *pedunculatus;* 7087 *sessilis;* 7305 *debilis;* 8337 *debilis* v. *elongatus;* 8573 *pedunculatus;* 8574 indet.; 8662 *Rogersii;* 9818 *fruticosus;* 9906 *campanuloides;* 13152 *fruticosus;* 13667 *pedunculatus.*

A. BOLUS. 4416 *alpinus.*

BOND. 817 *diffusus;* 1325 *crispus;* 1417 *fruticosus;* 1557 *sessilis.*

J. BORLE. 12 *rhodesicus.*

BURCHELL. 615 *nitidus;* 785 *fruticosus;* 964 *sessilis;* 4529 *campanuloides;* 4598 *campanuloides;* 5960 *Rogersii;* 7341 *debilis;* 7376 *sessilis;* 7551, 7586 *campanuloides;* 7596 *fruticosus;* 7613 *campanuloides;* 7665 *tenerrimus;* 7735 *debilis;* 7807 *diffusus;* 7969 *fruticosus;* 8280 *diffusus;* 8630 *campanuloides.*

BURTT-DAVY. 12111 *campanuloides.*

DE CASTELNAU. 268 *fruticosus;* 299 *fruticosus;* 334 *campanuloides.*

COMPTON. N.B.G. 76/48 *diffusus;* 2787 *fruticosus;* 3632 *crispus;* 5733 *pedunculatus;* 6232 *fruticosus;* 6233 *diffusus;* 8289 *sessilis;* 8309 *diffusus;* 8355 *fruticosus;* 8456 *alpinus;* 8474 *diffusus;* 8480 *fruticosus;* 8562 *nitidus;* 8575 *diffusus;* 8833 *diffusus;* 8850 *lycioides;* 9947 *pedunculatus;* 9951 *fruticosus;* 10056 *pedunculatus;* 10129 *fruticosus;* 10267, 10297 *fruticosus;* 12439 *diffusus;* 12502 *fruticosus;* 12540 *sessilis;* 12846, 12853 *fruticosus;* 12883 *brevilobus;* 12949, 12970 *diffusus;* 12976 *fruticosus;* 12986 *diffusus;* 13141 *campanuloides;* 13167 *virgatus;* 14441 *nitidus;* 14388 *Rogersii;* 14391 *Rogersii;*

15002 *pedunculatus;* 15498 *sessilis;* 15574, 15634 *fruticosus;* 15648 *diffusus;* 16665 *sessilis;* 16686 *fruticosus;* 16939, 16966 *sessilis;* 17882 *fruticosus;* 17913 *nitidus;* 18836 *crispus;* 18949 *diffusus;* 19057 *campanuloides;* 19350 *campanuloides;* 19387, 19454 *fruticosus;* 21925 *campanuloides.*

E. J. Cross. 2 *nitidus.*

Davidson. 16 *pedunculatus.*

Dinter. 3395 ?*Hildebrandtii;* 4478 *Hildebrandtii;* 8296 *Hildebrandtii.*

Drège. 1949, 1949a, 1949b *brevilobus;* 6324, 6325, 6326 *diffusus;* 6327, 6327a *fruticosus;* 6328 *lycopodioides;* 6329 *pedunculatus;* 6330 *campanuloides & crispus;* 8330b *crispus;* 6330c *campanuloides & crispus.*

Ecklon. 152 *sessilis;* 155 *nitidus;* 994 *diffusus.*

Ecklon & Zeyher. 3 *pedunculatus;* 9 *crispus;* 16 *nitidus;* 17 *sessilis;* 81 *campanuloides & fruticosus;* 101 *campanuloides;* 1078 *fruticosus;* 2373 *fruticosus;* 2389 *diffusus;* 2390 *pedunculatus;* 2391 *pedunculatus;* 2393 *fruticosus;* 2395 *brevilobus;* 2396 *campanuloides;* 2397 *crispus;* 2398, 2399 *campanuloides;* 2401 *Candolleanus;* 2402 *tenerrimus;* 2403 *nitidus;* 3146 *pedunculatus;* "94:11" *pedunculatus;* "1:11" *diffusus.*

Esterhuysen. 469 *nitidus;* 736 *pedunculatus;* 1299 *pedunculatus;* 1421 *crispus;* 1422 *crispus & Hildebrandtii;* 1578 *alpinus;* 1659 *brevilobus;* 1712 *debilis;* 1733 *alpinus;* 1909 *lycioides;* 1983 *fruticosus;* 2494 *diffusus;* 2546 *fruticosus;* 2787 *decurrens;* 3074 *fruticosus;* 3650 *fruticosus;* 3662 *pedunculatus;* 3710, 3954, 4049, 4102, 4140 *fruticosus;* 4389 *brevilobus;* 4400 *pedunculatus;* 4438 *crispus;* 4442 *diffusus;* 4448, 4463, 4465, 4469, 4486 *pedunculatus;* 4592 *fruticosus;* 4927 *tenerrimus;* 4992 *tenerrimus;* 4993 *Schlechteri;* 5074 *campanuloides;* 7135 *pedunculatus;* 7148 *crispus;* 7397, 7592 *fruticosus;* 7843 *sessilis;* 8598 *lycopodioides;* 8606, 8630, 8655 *brevilobus;* 8738, 8751, 8765 *brevilobus;* 8774 *fruticosus;* 9220 *pedunculatus;* 9861 *brevilobus;* 9893 *alpinus;* 9914 *pedunculatus;* 9915 *brevilobus;* 10033 *sessilis;* 10053 *nitidus;* 10082 *fruticosus;* 10855 *Rogersii;* 11103 *fruticosus;* 11344 *fruticosus;* 11381 *lycopodioides;* 11407 *sessilis;* 11485 *diffusus & tenerrimus;* 11487 *fruticosus;* 11495 *sessilis;* 12417 *brevilobus;* 12540, 12584 *sessilis;* 12749 *fruticosus;* 13431 *fruticosus;* 13374 *debilis;* 13375 *fruticosus;* 13519 *fruticosus;* 13536 *debilis;* 13625 *virgatus;* 13674 *cordifolius;* 13716 *sessilis* v. *macrocarpus;* 13729 *lycopodioides;* 13753, 13795 *brevilobus;* 13815 *pauciflorus;* 13820 *brevilobus & decurrens;* 13823 *brevilobus & decurrens;* 13904 *debilis;* 14139 *pedunculatus;* 14304 *altiflorus;* 14356 *fruticosus;* 14362 *brevilobus;* 14363 *lycopodioides;* 14376, 14378 *nitidus* v. *ovatus;* 14436 *lasiophyllus;* 14720 *pedunculatus;* 14856 *tenellus;* 14862 *debilis;* 14987 *diffusus;* 15031, 15088 *debilis;* 15124, 15168 *brevilobus;* 15935 *tenellus;* 16672 *debilis;* 16674 *tenellus;* 16684 *tenellus;* 16918 *implicatus;* 17661 *lycopodioides* v. *hispidus;* 17844 *altiflorus;* 17849 *crispus;* 17866 *fruticosus;* 18307 *debilis;* 18319 *lycopodioides;* 18446 *brevilobus;* 18473 *virgatus;* 18483 *brevilobus;* 19513 *campanuloides;* 19643 *pedunculatus;* 19760 *brevilobus;* 19768, 19831 *alpinus;* 19897 *brevilobus;* 19994 *tenellus.*

Fine. G72 *pedunculatus.*

Flanagan. 2454 *sessilis;* 3162 *rhodesicus.*

Fourcade. 1179, 1873 *campanuloides;* 3254 *Rogersii;* 3852 *Candolleanus;* 4528 *virgatus;* 5535 *Rogersii;* 6371 *Candolleanus.*

Galpin. 4309 *pedunculatus;* 9906, 9920 *campanuloides;* 10616 *fruticosus;* 10618 *diffusus;* 10719 *crispus;* 10836 *campanuloides;* 12311 *diffusus;* 12323 *diffusus;* 12317, 12342 *fruticosus;* 12418 *sessilis* v. *macrocarpus;* 12620, 12621 *brevilobus;* 12627 *fruticosus;* 12628 *fruticosus;* 12631 *diffusus;* 12718 *sessilis* v. *macrocarpus;* 12724, 12733 *sessilis;* 12738 *brevilobus;* 12849 *sessilis.*

GARSIDE. 443 *diffusus;* 447 *brevilobus;* 677 *fruticosus;* 1208 *diffusus.*

GILLETT. 539 *nitidus;* 630 *sessilis;* 663 *tenerrimus;* 680 *diffusus;* 689 *brevilobus;* 726 *campanuloides* v. *dentatus;* 740 *diffusus;* 791 *diffusus;* 844 *campanuloides;* 847, 865 *fruticosus.*

GILMAN. 1963 *diffusus.*

GODMAN. 779 *pedunculatus.*

A. L. GRANT. 2257 *diffusus.*

GUTHRIE. 999 *fruticosus;* 1490 *nitidus;* 1501 *fruticosus;* 2176 *diffusus;* 2273 *fruticosus;* 2653 *pedunculatus;* 2762 *fruticosus;* 3662 *diffusus;* 4345 *campanuloides.*

HAFSTROM & ACOCK. 1502 *campanuloides;* 2007 *pedunculatus;* 2009 *tenerrimus.*

HARVEY. 219, 247, 267 *sessilis;* 5020 *nitidus.*

HUTCHINSON. 1462 *campanuloides.*

JOHNSON. 4 *campanuloides;* 7253 *brevilobus.*

LAUGHTON. 132 *hispidus.*

LEIGHTON. 924 *sessilis;* 2378 *crispus;* 2612, 2833 *campanuloides.*

LEIPOLDT. 570, 571 *pedunculatus;* 641, 659, 670 *fruticosus;* 3709, 3710 *fruticosus;* 3711 *diffusus;* 4348 *fruticosus;* 4349 *diffusus.*

LEVYNS. 558, 1341, 3276, 3475, 4421 *pedunculatus;* 5097 *fruticosus.*

LEWIS. 58479 *diffusus.*

LIEBENBERG. 4322 *pedunculatus.*

F. R. LONG. 286, 535, 541 *campanuloides.*

MACOWAN. 922, 1083 *campanuloides;* 2955 *diffusus;* 3177 *fruticosus.*

MARLOTH. 1648, 2363 *alpinus;* 2366 *fruticosus;* 2368 *alpinus;* 3424 *nitidus;* 5599, 8150 *diffusus;* 8355 *campanuloides;* 8408, 9483 *sessilis;* 10002, 10102 *diffusus;* 11840 *pedunculatus;* 12013 *diffusus;* 12098 *fruticosus;* 12550 *crispus.*

B. MARLOTH. 9, 48 *diffusus.*

R. H. MARLOTH. 110 *fruticosus.*

B. MARTIN. 298 *brevilobus.*

MEYER. 1869 *Hildebrandtii.*

MILNE. 169 *sessilis.*

MOSS. 7432 *fruticosus;* 7503 *sessilis;* 7505 *fruticosus.*

MOSS & ROGERS. 1531 *diffusus;* 1550 *diffusus.*

MUIR. 1283 *campanuloides;* 1371 *cliffortioides;* 1957 *campanuloides;* 2781 *pedunculatus.*

NORMAN. 328 *diffusus.*

PATERSON. 485, 1212 *campanuloides;* 1253 *Rogersii;* 19094 *diffusus.*

PEARSON. 3524, 5126, 5280 *pedunculatus;* 5332 *crispus;* 5720 *diffusus;* 5309 *diffusus;* 7120, 7202 *pedunculatus;* 9060 indet.

PENFOLD. 248 *brevilobus.*

PENTHER. 2750 *brevilobus;* 2757 *campanuloides.*

E. P. PHILLIPS. 1795 *brevilobus & diffusus;* 1976 *brevilobus;* 1977 *fruticosus;* 1979 *alpinus.*

PILLANS. 2378 *crispus;* 6102 *diffusus;* 7129 *crispus;* 7915, 8587 *pedunculatus;* 8588 *crispus;* 8618, 8709 *pedunculatus;* 8731 *altiflorus;* 8772, 9060 *pedunculatus;* 9586 *crispus.*

Pocock. S.116 *tenerrimus.*
Rattray. 1382 *campanuloides.*
Rehmann. 2408 *diffusus;* 2470 *fruticosus;* 2474 *pedunculatus;* 2477 *tenellus;* 2594 *fruticosus;* 2694, 5889 *fruticosus.*
Rodin. 3074 *fruticosus;* 3079 *diffusus;* 3255 *nitidus* v. *ovatus;* 3271 *diffusus.*
Rogers. 193 *campanuloides;* 3259 *campanuloides;* 5617 *rhodesicus;* 10517 *diffusus;* 16199 *Rogersii;* 16851 *fruticosus;* 17327 *diffusus;* 27638 *campanuloides;* 29286 *diffusus.*
Ryder. 64 *campanuloides.*
Salter. 292/22 *nitidus;* 292/23 *sessilis;* 292/30 *fruticosus;* 371/17 *campanuloides;* 373/11 *diffusus;* 376/41 *campanuloides;* 376/42 *hispidus;* 1794 *crispus;* 1924, 2010 *diffusus;* 2011 *fruticosus;* 2023, 2028 *brevilobus;* 2041 *fruticosus;* 2076, 2119 *brevilobus;* 2979 *diffusus;* 3252 *hispidus;* 4219 *sessilis* v. *macrocarpus;* 4225 *diffusus;* 4257 *sessilis* v. *macrocarpus;* 4284 *sessilis;* 5155 *tenerrimus;* 5945 *fruticosus;* 7991 *nitidus.*
Schlechter. 23, 224 *sessilis;* 306 *fruticosus;* 505 *nitidus;* 1160 *diffusus;* 2400 *campanuloides;* 5630 *pedunculatus;* 7274 *fruticosus;* 7283 *diffusus;* 7350 *brevilobus;* 7375 *fruticosus;* 7670 *Schlechteri;* 9050, 9070 *pedunculatus;* 9171 *lycopodioides;* 9766 *tenerrimus* (p.pte); 9768 *tenerrimus;* 9775 *debilis* v. *elongatus;* 9882 *debilis;* 10181 *pedunculatus;* 10284 *campanuloides;* 10298 *debilis;* 10319 *tenerrimus;* 10385 *sessilis;* 10595 *campanuloides.*
Scott-Elliott. 221 *diffusus.*
C. A. Smith. 4277 *campanuloides;* 7283 *diffusus.*
Stephens. 6379 *pedunculatus.*
Stokoe. 1096 *diffusus;* 3096 *fruticosus;* 7165 *diffusus;* 7545 *campanuloides;* 9110 *tenerrimus;* 9380 *pedunculatus;* 58486 *fruticosus;* 58487 *campanuloides.*
Story. 2403 *campanuloides;* 3594 *pedunculatus.*
L. E. Taylor. 1634 *Rogersii.*
Theiler. 51 *diffusus.*
Thode. A2164 *crispus;* A2257 *diffusus.*
Tyson. 744 *fruticosus;* 799 *diffusus;* 925 *diffusus;* 961 *fruticosus;* 3053 *diffusus.*
Van Breda. 181 *pedunculatus;* 228 *fruticosus.*
Walgate. 245 *fruticosus;* 345a *pedunculatus.*
Wall. 18, 80/39, 82/39, 84/39 *fruticosus;* 502/53 *sessilis.*
Wallich. 411 *sessilis.*
Wasserfall. 170, 777 *fruticosus;* 806 *pedunculatus;* 821 *diffusus.*
Wolley-Dod. 181 *fruticosus;* 276, 297 *sessilis;* 676 *nitidus;* 677 *nitidus;* 849 *nitidus;* 1966 *fruticosus;* 2128, 2611 *sessilis.*
Zeyher. 101, 203 *campanuloides;* 278 *sessilis;* 377 *diffusus;* 750 *sessilis;* 1021 *diffusus;* 1077 *pedunculatus;* 1078, 1078a, 1078b *fruticosus;* 1079 *diffusus;* 1080 *sessilis;* 1081 *diffusus;* 2393 *fruticosus;* 2398 *campanuloides;* 3145, 3145a, 3145b *pedunculatus;* 3146 *pedunculatus;* 3147 *fruticosus;* 3148 *campanuloides;* 4902 *nitidus.*

Roella.

Acock. 1255 *ciliata;* 2316 *prostrata;* 2848 *amplexicaulis;* 3962 *ciliata;* 3956 *prostrata;* 4901 *muscosa;* 9550 *glomerata;* 10906 *glomerata.*
Adamson. 183 *Goodiana;* 522 *prostrata;* 656, 670 *ciliata;* 686 *ciliata;* 688 *amplexicaulis;* 689 *ciliata;* 689A *ciliata* × *triflora;* 693 *prostrata;* 694 *amplexicaulis;* 695 *triflora;* 701, 741 *ciliata* × *triflora;* 823 *Goodiana;* 827 *amplexicaulis;* 855 *prostrata;* 1584 *amplexicaulis;* 1597 *ciliata* × *triflora;* 1617, 1620 *squar-*

rosa; 1627 *muscosa;* 1642 *squarrosa;* 1653, 1654 *triflora;* 1678 *amplexicaulis;* 1722 *recurvata;* 1726 *prostrata;* 1752 *squarrosa;* 1763, 1764 *triflora;* 2351, 2389 *triflora;* 2402 *amplexicaulis;* 2407, 2433 *triflora;* 2434 *squarrosa;* 2456 *prostrata;* 2461A *compacta;* 2468 *amplexicaulis;* 2469 *recurvata;* 2473 *squarrosa;* 2738 *muscosa;* 2768 *recurvata;* 2769, 2774 *prostrata;* 3156 *recurvata;* 3315 *ciliata;* 3487 *prostrata;* 3494 *decurrens;* 3496 *recurvata;* 3569, 3636, 3739 *Dregeana;* 3777 *rhodantha;* 3841, 3850 *incurva;* 3852 *incurva* × *maculata;* 3853 *incurva;* 3854, 3855, 3856 *incurva* × *maculata;* 3857 *maculata;* 3859, 3860 *incurva;* 3861 *incurva* × *maculata;* 3881 *maculata;* 3891, 3892 *incurva* v. *rigida;* 3893 *rhodantha;* 3894 *rhodantha;* 3895, 3897 *incurva* v. *rigida;* 3902 *secunda;* 3903 *rhodantha;* 3904 *incurva* × *rhodantha;* 3905 *incurva* v. *rigida;* 3912 *incurva* × *rhodantha;* 3913 *rhodantha;* 3915, 3916 *incurva* × *rhodantha;* 3917 *rhodantha;* 3918 *secunda;* 3920, 3921 *maculata;* 3926 3927, 3928, 3929 *ciliata;* 4020, 4025 *ciliata;* 4028, 4030, 4032 *incurva;* 4034 *ciliata;* 4037, 4039, 4044 *Dunantii;* 4045 *ciliata;* 4047 *incurva* × *maculata;* 4048 *incurva;* 4049, 4050, 4051, 4069 *incurva;* 4081, 4084, 4091, 4094, 4098, 4100, 4101, 4103, 4104 *incurva;* 4128, 4129 *incurva;* 4134, 4135, 4136, 4137, 4140, 4141, 4142, 4143A, 4144, 4145, 4146, 4147, 4148, 4149, 4150, 4151, 4152, 4153, 4154, 4155 *incurva;* 4158 *ciliata;* 4160, 4161 *maculata;* 4162A, 4163 *incurva;* 4167 *incurva* × *maculata;* 4168, 4169 *maculata;* 4170 *incurva;* 4175 *maculata;* 4176, 4177 *incurva;* 4178 *maculata;* 4179, 4182, 4186 *incurva;* 4189 *psammophila;* 4191 *incurva* × *psammophila;* 4192 *incurva* × *psammophila;* 4193, 4194 *psammophila;* 4195, 4196 *incurva* × *psammophila;* 4198 *psammophila;* 4202, 4205 *incurva* × *psammophila;* 4206, 4207, 4211, 4212, 4213 *incurva;* 4218, 4219 *incurva;* 4301, 4307 *incurva;* 4309, 4313, 4315 *incurva* × *rhodantha;* 4317 *incurva;* 4317A *incurva* × *rhodantha;* 4321 *incurva;* 4352, 4363 *spicata;* 4368, 4371, 4374 *spicata;* 4412, 4413, 4418, 4419, 4420 *incurva;* 4421 *cuspidata;* 4427, 4430, 4436, 4438 *incurva;* 4441 *Dregeana;* 4443, 4451 *incurva;* 4452 *cuspidata;* 4455 *prostrata;* 4454 *muscosa;* 4456, 4457 *incurva* × *maculata;* 4458, 4459, 4460 *incurva.*

ANDREAE. A251 *squarrosa;* 1089 *triflora.*

BARKER. 199 *ciliata;* 698 *triflora;* 1200 *incurva;* 1289 *glomerata;* 2431 *ciliata;* 3343 *incurva;* 3949 *prostrata;* 3955 *triflora;* 4018 *amplexicaulis;* 5279 *incurva;* 5293 *compacta;* 7195 *cuspidata.*

BOLUS. 78 *prostrata;* 86 *ciliata;* 2268 *prostrata;* 2763 *secunda;* 2981 *amplexicaulis & squarrosa;* 3291 *prostrata;* 3323 *ciliata & incurva;* 3885 *muscosa;* 4060 *Dregeana;* 4714 *triflora;* 6949 *cuspidata;* 7881 *secunda;* 7966 *decurrens;* 8571 *cuspidata;* 8572 *compacta;* 8750 *incurva & arenaria;* 8752 *arenaria;* 9235 *cuspidata;* 11426 *squarrosa;* 12102 *secunda.*

BOND. 922 *spicata;* 964 *muscosa.*

BRITTEN. 3114 *incurva.*

BURCHELL. 96 *ciliata;* 636 *muscosa;* 639 *muscosa;* 874 *ciliata;* 4481 *secunda;* 4645 *spicata;* 6677 indet.; 6849 *spicata* v. *Burchellii;* 7884, 7957 *incurva;* 7923 *spicata;* 7986 *spicata;* 8144 *Dregeana;* 8532 *ciliata.*

BURTT-DAVY. 18532 *incurva;* 18566 *incurva.*

DE CASTELNAU. 294 *secunda;* 370 *ciliata;* 371 *prostrata;* 447 *ciliata.*

COMPTON. 5289 *spicata;* 8173 *incurva;* 8482 *squarrosa;* 8542 *squarrosa;* 8709 *decurrens;* 10229 *incurva;* 10264 *arenaria;* 10624 *amplexicaluis;* 12377 *incurva;* 12939 *muscosa;* 12998 *amplexicaulis;* 13002 *triflora;* 13016 *squarrosa;* 14257 *incurva;* 14282 *amplexicaulis;* 14287 *triflora;* 14457 *squarrosa;* 14546 *triflora;* 15483 *squarrosa;* 16819 *incurva;* 16940 *prostrata;* 16944 *ciliata* × *triflora;* 17377 *decurrens;* 17921 *prostrata;* 18956 *incurva;* 19031 *compacta;* 19368 *recurvata;* 19408 *psammophila;* 20375 *triflora;* 20411 *incurva* v. *rigida;* 20440 *incurva;* 20997 *cuspidata* v. *hispida;* 21839 *triflora;* 21847 *amplexicaulis;* 21887 *squarrosa.*

Debeaux. 13 *ciliata.*

Drège. 6305 *muscosa;* 6321 *spicata;* 6322 *latiloba;* 6323 *recurvata;* 4011 *glomerata;* 7837 *incurva.*

Ecklon. 64 *ciliata;* 81 *incurva & ciliata;* 283 *prostrata;* 286 *incurva;* 694 *ciliata;* 696 *squarrosa;* 2405 *ciliata;* 2416 indet. 2445 *ciliata.*

Ecklon & Zeyher. 4 *Dunantii;* 92:10 *ciliata;* 2405 *incurva, ciliata & Dunantii;* 2406 *bryoides, ciliata & prostrata;* 2407 *bryoides & incurva;* 2408 *prostrata & spicata;* 2409 *prostrata;* 2410 *spicata;* 2411 *?bryoides;* 2412 *squarrosa;* 2413 *muscosa;* 2414 *secunda;* 2415 *secunda;* 2416 *spicata.*

Elliot. 63 *ciliata;* 113 *ciliata.*

Esterhuysen. 1 *decurrens;* 1B *decurrens;* 36 *decurrens;* 48, 48A *ciliata;* 2893 *ciliata;* 3511 *incurva;* 4228 *incurva;* 4693 *spicata;* 5019 *psammophila;* 8624 *Dregeana;* 9984 *muscosa;* 10034, 11389 *squarrosa;* 12595 *maculata;* 12616 *incurva;* 12630 *decurrens & squarrosa;* 14373 *muscosa;* 15191 *ciliata;* 16777 *spicata;* 16791 *spicata;* 28393 *ciliata.*

Fairall. 197 *amplexicaulis.*

Flanagan. 460 *glomerata;* 2403 *decurrens.*

Fourcade. 2073 *spicata;* 2486 *spicata;* 5910, 5917 *spicata.*

Fries. 3001 *ciliata.*

Galpin. 3129 *glomerata;* 4308 *ciliata;* 4314 *incurva;* 4905 *squarrosa;* 11245, 11245a *cuspidata;* 11302 *incurva;* 12293, 12294 *incurva;* 12299 *prostrata;* 12448 *triflora;* 12555 *squarrosa & recurvata;* 12722 *prostrata;* 12723 *recurvata;* 12724 *amplexicaulis.*

Garside. 1167 *ciliata.*

Gerrard. 395 *glomerata;* 623 *glomerata;* 1502 *glomerata.*

Gerrard & McKen. 872 *glomerata.*

Gillett. 561 *incurva;* 571 *psammophila;* 618 *maculata;* 625 *incurva;* 687, 688 *incurva;* 770 *squarrosa.*

Gilmore. 20749 *incurva.*

Godman. 856 *triflora.*

A. L. Grant. 2627 *ciliata.*

Guthrie. 304 *prostrata;* 998 *ciliata;* 1375 *amplexicaulis & triflora;* 4480 *cuspidata;* 4956 *cuspidata.*

Hafstrom & Acock. 2010 *spicata.*

Harvey. 11 *ciliata;* 454 *ciliata;* 579 *squarrosa;* 1153 *spicata;* 12116 *Dregeana.*

Henderson. 1404 *ciliata.*

Hilner. 280 *glomerata.*

Jamieson. 13 *ciliata.*

Kensit. 11426 *squarrosa.*

Kies. 13 *decurrens.*

Leighton. 901 *incurva;* 2343 *compacta;* 2463 *incurva.*

Levyns. 2695 *maculata;* 3129 *ciliata;* 5133 *Goodiana;* 5511 *prostrata;* 5616 *amplexicaulis;* 5617 *recurvata;* 8798 *psammophila.*

F. R. Long. 497 *spicata;* 926 *spicata.*

W. J. Louw. 133 *ciliata.*

MacGillivray. 657 *ciliata;* 658 *triflora;* 659 *amplexicaulis.*

MacOwan. 78 *prostrata;* 86 *ciliata;* 1633 *glomerata;* 2366 *ciliata;* 3013 *Dunantii;* 3059 *prostrata;* 3291 *prostrata.*

Marloth. 110 *incurva;* 405 *ciliata;* 5933 *ciliata;* 8410 *prostrata;* 10009 *Dunantii.*

B. Martin. 622 *incurva.*

Milne. 154 *amplexicaulis;* 181 *ciliata;* 213 *triflora.*

Mogg. H13686, H13746 *squarrosa.*

Morris. 5 *decurrens.*

Moss. 1702 *decurrens;* 5056 *ciliata;* 5057 *prostrata;* 7433 *incurva;* 7433 bis *maculata;* 7491 *amplexicaulis;* 7506, 7507 *triflora;* 7508 *Goodiana;* 7530 *muscosa;* 7554 *ciliata;* 7558 *squarrosa;* 7561 *ciliata;* 9019 *ciliata;* 9837 *prostrata;* 15323 *spicata;* 17465 *ciliata;* 18992 *prostrata;* 18993 *decurrens;* 19002 *amplexicaulis;* 21338 *secunda;* 24891 *ciliata.*

Moss & Rogers. 18993 *squarrosa.*

Muir. 3166 *secunda.*

Naude. 49 *ciliata.*

Paterson. 92 *ciliata.*

Penther. 2736 *ciliata;* 2759 *insizwae.*

Pillans. 2543 *compacta;* 6750 *incurva;* 8157 *compacta;* 8195 *incurva & maculata;* 8206 *maculata;* 9441 *rhodantha.*

Potts. 1795 *glomerata;* 5016 *incurva.*

Rehmann. 1045 *ciliata;* 1046 *ciliata.*

Rodin. 3101 *incurva.*

Rogers. 1069 *ciliata;* 16985 *ciliata;* 17405 *incurva.*

Ryder. 153 *amplexicaulis;* 154 *ciliata;*

Salter. 292/11, 292/11B *triflora;* 292/12 *ciliata* × *triflora;* 292/12A *amplexicaulis;* 292/13 *prostrata;* 292/14 *compacta;* 292/16 *recurvata;* 292/17A *Goodiana;* 292/17B *squarrosa;* 292/19 *squarrosa;* 292/22 *ciliata* × *triflora;* 1883 *triflora;* 1905, 1919 *triflora;* 1943 *Goodiana;* 1944 *triflora;* 1958 *squarrosa;* 2000 *triflora;* 2029 *incurva;* 2035 *ciliata;* 2956 *prostrata;* 2993, 2993A *squarrosa;* 3245 *spicata;* 4112 *compacta;* 4175 *incurva;* 4176 *incurva;* 4217 *Dunantii & prostrata;* 4263 *recurvata;* 4274 *prostrata;* 4322 *squarrosa;* 5172 *maculata;* 5214, 5214A 5219, 5225 *incurva;* 5733 *triflora;* 5756 *amplexicaulis;* 5759 *triflora;* 5773 *decurrens;* 5783 *squarrosa;* 5801 *Goodiana;* 5826 *recurvata;* 5889 *amplexicaulis;* 6492 *ciliata* × *prostrata;* 8008 *compacta;* 8710 *ciliata.*

Schlechter. 10 *ciliata;* 164 *muscosa;* 209 *triflora;* 302 *prostrata;* 598 *amplexicaulis;* 1758 *spicata;* 2833 *glomerata;* 7282 *ciliata & Dunantii;* 7321 *recurvata;* 7397 *lightfootioides;* 7401 *cuspidata;* 7436 *psammophila;* 7483 *Dregeana* v. *nitida;* 9179 *Dregeana;* 9691 *arenaria;* 9714 *compacta;* 9858 *Dunantii & psammophila;* 9905 *bryoides & prostrata;* 10593 *arenaria.*

Scott-Elliott. 95 *ciliata.*

Shantz. 60 *ciliata.*

Sieber. 78 *ciliata.*

C. A. Smith. 2524 *maculata;* 3829 *glomerata;* 5033 *latiloba.*

Steudel. 2405 *ciliata.*

L. E. Taylor. 1586 *compacta.*

Thode. A2210 *incurva;* A2346 *spicata;* A2347 *spicata.*

Tyson. 2343 *ciliata.*

Walgate. 431 *amplexicaulis.*

Wall. 439/30 *spicata;* 860/8 *triflora;* 899/9 *ciliata;* 2475 *spicata;* 2485, 2491 *spicata;* 3138 *prostrata.*

WASSERFALL. 776 *ciliata* × *prostrata.*

WEEKS. 87 bis *glomerata.*

WILMS. 3390, 3890 *ciliata.*

WOLLEY-DOD. 182 *ciliata;* 687 *prostrata;* 806 *squarrosa;* 808 *amplexicaulis & squarrosa;* 2208 *prostrata;* 2230 *decurrens & squarrosa;* 2320 *triflora;* 2395 *squarrosa.*

WOOD. 233 *glomerata;* 397 *glomerata;* 1003, 1033 *glomerata;* 5524 *glomerata;* 7504 *glomerata.*

ZEYHER. 9 *incurva;* 447 *secunda;* 694, 695 *incurva;* 748 *ciliata;* 827 indet; 1082 *bryoides;* 2408 *spicata & prostrata;* 2409 *arenaria;* 2410 *spicata;* 2414 *spicata;* 2415 *secunda;* 3149 *incurva;* 3150, 3151 *secunda;* 3417 *ciliata, prostrata & spicata.*

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NOTES ON SOUTH AFRICAN MARINE ALGAE. III.

By George F. Papenfuss.

Study of the South African marine algae has revealed that many of the names which had previously been applied to these plants cannot be maintained. In some instances the accepted name has to be abandoned because it is misapplied, in others because it is a later synonym. Although the primary purpose of the present article is to discuss the identity and the more pertinent nomenclature of certain species, notes of a morphological and distributional nature have been added in so far as it seems desirable to do so at this time. The first two papers in this series are listed in the bibliography.

Grateful acknowledgment is made to the Carnegie Corporation of New York for a Grant-in-aid, received through the University of Cape Town (1939–1940), and to the Guggenheim Foundation for a Fellowship (1949–1950) which made it possible for me to study, in European herbaria, the types and various other published specimens referred to in this paper.

CHLOROPHYCOPHYTA.

Chamaedoris Delphini (Har.) Feldm. et Børg.

Chamaedoris Delphini (Har.) Feldmann et Børgesen, *in* Børgesen, K. Danske Vidensk. Selsk. Biol. Medd. 15 (4): 16, fig. 5, pl. 1, 1940.

Siphonocladus Delphini Hariot, Bull. Mus. Hist. Nat. [Paris] 8: 470, 1902.

Comparison of the South African plant which for a long time has passed as *Chamaedoris annulata* Mont. [or *C. Peniculum* (Ellis et Soland.) O. Kuntze as this taxon should be known] with Børgesen's description of *C. Delphini* has shown that it should be referred to this species. The type locality of *C. Delphini* is Fort-Dauphin, Madagascar. In addition to Madagascar, the species is now known from Mauritius and the east coast of South Africa.

Caulerpa ambigua Okam.

Caulerpa ambigua Okamura, Bot. Mag. Tokyo 11: 4, pl. 1, figs. 3–12, 1897.

In the course of examining preserved material of algae collected by Pocock and Papenfuss in July, 1938, at Umhlali Beach (north of Durban), Dr. Lois Eubank came across specimens of this diminutive species. This constitutes the first record of the occurrence of *Caulerpa ambigua* in

South Africa. Previously the species had been known from the Caribbean, the tropical Pacific, and Mauritius (cf., Eubank 1946; Børgesen 1949).

Børgesen (1949, p. 8) prefers to retain the name *Caulerpa Vickersiae* Børgesen (1911) for this taxon because he "... was the first to give a proper description of the species." It is true that Okamura's (1897) description of *C. ambigua* is misleading, but nonetheless it is sufficient to validate this name, which according to the International Rules of Botanical Nomenclature must be retained.

Caulerpa selago (Turn.) C. Ag.

Caulerpa selago (Turn.) C. Agardh, Sp. alg. 1 (2): 442, 1822.

Fucus selago Turner, Fuci 1: 122, pl. 55, 1808.

Chauvinia selago (Turn.) Kützing, Sp. alg.: 497, 1849; Tab. phyc. 7: 5, pl. 11, fig. 1, 1857.

This species is here reported for the first time from South Africa. For a long time it was known only from the Red Sea, but in more recent times it was obtained also in New Guinea (Weber-van Bosse 1898) and the Sulu Archipelago (Weber-van Bosse 1913). The South African plants of *Caulerpa selago* were collected by Pocock and Papenfuss in July, 1938, near the mouth of the St. Lucia Estuary in northern Natal, and agree very well with specimens of this species in Herb. Agardh (No. 16636) which were collected in the Red Sea by Rüppel and published by J. Agardh (1837).

PHAEOPHYCOPHYTA.

Zonaria subarticulata (Lamour.) Papenf.

Zonaria subarticulata (Lamour.) Papenfuss, Farlowia 1: 339, 1944 (excl. syns. *Zonaria Turneriana* J. Ag. and *Phycopteris angustata* Kütz.).

Dictyota subarticulata Lamouroux, Nouv. Bull. Sci. Soc. Philom., sér. 2, 1: 331, 1809 (pro parte); Jour. de Bot. 2: 41, 1809 (pro parte).

Dictyota interrupta Lamouroux, Ann. Mus. Hist. Nat. [Paris] 20: 272, pl. 12. fig. 1. 1813.

Zonaria interrupta (Lamour.) C. Agardh, Sp. alg. 1 (1): 137, 1820 (pro parte).

Zonaria cuneata (Kütz.) Papenfuss, Farlowia 1: 340, 1944.

Phycopteris cuneata Kützing, Tab. phyc. 9: 27, pl. 67, fig. II, 1859.

The identity of *Dictyota subarticulata* has been discussed previously by Papenfuss (1944), who concluded that this name applied to the Australian plant which J. Agardh in 1871 described as *Zonaria Turneriana*—not to the South African species which had passed as *Z. interrupta*. This conclusion was based primarily upon two facts. (1) There was no evidence that either of the two collectors (Thouin and De la Billardière) who had furnished Lamouroux with the material of *D. subarticulata* had visited South Africa, whereas De la Billardière had collected in Australia. (2) In the paper in which Lamouroux (1809*a*) described *Dictyota subarticulata*, he reported upon a number of Australian species, but not a single one from South Africa.

In determining the identity and status of *Dictyota subarticulata* and *D. interrupta* (=*Zonaria interrupta*), three of Lamouroux's publications come up for consideration: 1809*a*, 1809*b*, and 1813. In each of these publications, Lamouroux treats 23 species of *Dictyota*. The names of the species and the sequence in which they are taken up is the same, except that the name of number 7, *Dictyota subarticulata*, as given in the first two publications, is changed to *D. interrupta* in the "Essai" and the locality is here given as "Ind. orient." only instead of "Ind. Or., Nov. Hol." as in 1809. Since *D. subarticulata* or a species resembling it had not been obtained in the East Indies since the time of Lamouroux's writings, Papenfuss suggested that this locality may have been given in error.

Through the kindness of Dr. Roger Meslin and Professor Jean Feldmann, I had the opportunity during the summer of 1950 of examining Lamouroux's material of *Dictyota subarticulata*. According to the notes of Lamouroux which accompany the material, his specimens were supplied by De la Billardière, who had obtained plants at "Cap de Diemen," and by Thouin, who had received specimens from Commerson who had collected them on the coast of Madagascar. It is clear, therefore, that "India orientali" in the sense of Lamouroux applies to Madagascar.

In deciding whether Madagascar or Australia should be regarded as the type locality of *Dictyota subarticulata*, the evidence weighs heavily in favour of Madagascar.

First, the introduction of the name *Dictyota interrupta* by Lamouroux in his "Essai" in 1813, when he gave as locality only "Ind. orient.", probably was an intentional change of name (a relatively common practice in those days which is not sanctioned by present-day rules of nomenclature) rather than an intentional removal of the material from Madagascar to a separate species. As in the case of the other 22 species of *Dictyota*, Lamouroux cited the "Bull. philom." as the place of publication (where he used the name *D. subarticulata*).

Second, Lamouroux's herbarium at present contains only one packet of material under the name *Dictyota subarticulata*, and it is labelled: "inconnu à Linne en 1779. Apporté par Commerson de Madagascar."

Third, Herb. Lamouroux contains a specimen of *Zonaria* from Australia ("N. Holl.") under the names "Dictyota obscura" and "Fu. interruptus Turn." Although there is no proof that this is the material which

Lamouroux had received from De la Billardière, it is evident that Lamouroux had removed the Australian plant to a separate species which he had associated with the plant which Turner (1819) had described and illustrated as *Fucus interruptus*.

On the basis of the information yielded by the material in Herb. Lamouroux, it thus becomes necessary to employ the name *Zonaria subarticulata* (Lamour.) Papenf. for the species from Madagascar; and since this species is conspecific with *Zonaria cuneata* (Kütz.) Papenf., the latter name, which is based upon material from South Africa, must be relegated to synonymy.

Zonaria angustata (Kütz.) Papenfuss, comb. nov.

Phycopteris angustata Kützing, Tab. phyc. 9: 28, pl. 69, fig. 1, 1859.

Zonaria Turneriana J. Agardh, Öfvers. K. Sv. Vetensk.-Akad. Förhandl. 27: 438, 1871; Till alg. syst. [afd. 1]: 48, 1872.

In the discussion of *Zonaria subarticulata* it was pointed out that according to the type specimen this name applies to a species from Madagascar (which also occurs in South Africa). The plant from Australia which has been confused with *Z. subarticulata* (or *Z. interrupta* as the latter has been known for a long time) was first described as an independent species by Kützing (1859) under the name *Phycopteris angustata*, and it is necessary to restore this epithet as *Z. angustata* (Kütz.) Papenf. This species is generally regarded as having a wide distribution in the southern hemisphere, occurring in Tasmania and New Zealand and neighbouring islands in addition to Australia. In connection with his report upon the algae of the Chatham Islands, J. Agardh (1871) described what appears to be the same species as *Z. Turneriana*, and this name was for a long time employed for the plant from the southern seas. The apparent superfluity of this name was already implied by J. Agardh (1872), for he listed *P. angustata* as a synonym of *Z. Turneriana*.

Phyllaria reniformis (Lamour.) Rostaf.

Phyllaria reniformis (Lamour.) Rostafinsky, *in* Bornet, Alg. Schousboe: 250, 1892.

Laminaria reniformis Lamouroux, Ann. Mus. Hist. Nat. [Paris] 20: 42, pl. 7, fig. 3, 1813.

When establishing this species, Lamouroux cited South Africa as the source of his specimens. However, this record was based on a transposition of labels. The species is at home in the western Mediterranean and the Atlantic coasts of southern Europe and North Africa. According to Hamel (1931–1939, p. 308), the specimens of Lamouroux correspond well with plants of *Phyllaria reniformis* from the Mediterranean.

Sargassum heterophyllum (Turn.) C. Ag.

Sargassum heterophyllum (Turn.) C. Agardh, Sp. alg. 1 (1): 21, 1820 (pro parte).
Fucus heterophyllus Turner, Fuci 2: 62, pl. 92, 1809 (pro parte).
Sargassum incisifolium (Turn.) C. Agardh, Sp. alg. 1 (1): 14, 1820.
Fucus incisifolius Turner, Fuci 4: 39, pl. 214, 1819.

The uncertainty concerning the source and the identity of the type material of *Sargassum heterophyllum* was briefly discussed by Papenfuss (1940*b*) in an earlier paper. It was pointed out that the type locality of *Fucus heterophyllus* probably was South Africa despite the fact that when describing the species Turner mentioned only "Coast of Japan" and "Coast of New Holland." The association of the type of *F. heterophyllus* with a species from South Africa was made on the authority of the late Professor Setchell, who had seen Turner's type in the Linnean Herbarium and had identified it with the species from South Africa which J. Agardh (1848) and others had previously referred to *Sargassum heterophyllum.*

During the summer of 1950, I also had an opportunity of examining the type of *Fucus heterophyllus* in the Linnean Herbarium. This specimen (No. 1274–40 of Savage's catalogue, 1945) is named "heterophyllus D. T." and is the one illustrated by Dawson Turner. Although the source of the specimen is not indicated, I concur with the opinion of Setchell that it is representative of a species which is common in South Africa. Concerning the possible identity of the Australian and Japanese plants which Turner referred to *Sargassum heterophyllum*, reference should be made to the article by Papenfuss (1940*b*, p. 9) where Setchell's opinions are stated.

Observations in the field and study of liquid-preserved and dried specimens of *Sargassum incisifolium*, which was described by Turner in 1819 (as *Fucus incisifolius*) on the basis of material from South Africa, has shown that this taxon is conspecific with *S. heterophyllum.* As is often true in *Sargassum*, the plants of *S. heterophyllum* tend to be dioecious, and the male and female receptacles differ in form. The plants which are largely male represent the stage which usually has been assigned to *S. incisifolium* and those which contain largely female conceptacles have usually been referred to *S. heterophyllum.*

RHODOPHYCOPHYTA.

Erythrotrichia Welwitschi (Rupr.) Batt.

Erythrotrichia Welwitschi (Rupr.) Batters, Cat. Brit. mar. alg.: 55, 1902.
Cruoria? Welwitschi Ruprecht, Tange Ochotsk. Meeres: 332, pl. 18, fig. i, 1851.

Bangia ciliaris sensu Barton, Jour. Bot. 34: 459, 1896. Non *Bangia ciliaris* Carmichael, *in* Hooker, Brit. fl. 2: 316, 1833=*Erythrotrichia ciliaris* (Carm.) Thuret, *in* Le Jolis, Alg. mar. Cherbourg: 103, 1863.*

An examination of the material, collected by Mrs. Weber-van Bosse at Sea Point (in Ryksherbarium, Leiden), upon which Barton (1896) established the record of *Bangia ciliaris* has shown that it is representative of *Erythrotrichia Welwitschi.* This necessitates the removal of *B. ciliaris* from the flora of South Africa and the addition of *E. Welwitschi.* The plants of Weber-van Bosse were epiphytic on *Ralfsia*, and I have obtained it on the same host at the Cape Town esplanade and at Kommetjie in the Cape Peninsula.

Erythrotrichia Welwitschi was described by Ruprecht (as *Cruoria? Welwitschi*) incidental to his treatment of *Cruoria pellita* in his "Tange des Ochotskischen Meeres." Ruprecht's material occurred on *Ralfsia* which had been collected by Welwitsch at Lisbon, Portugal. He pointed out (correctly as we now know) that *Cruoria? Welwitschi* probably belonged at an entirely different place in the system.

Apparently unaware of Ruprecht's species, J. Agardh in 1876 (p. 15) described Welwitsch's plant as *Callithamnion Welwitschii.* (According to J. Agardh, Welwitsch had distributed the plant as *C. Daviesii* under No. 182 of his "Phyc. Lus.") In the same work (p. 12), J. Agardh published another plant of Welwitsch from Portugal ("Wellw. Phyc. Lus. n:o 23") under the name *C. lepadicola*, which according to Batters (1902) is synonymous with *Erythrotrichia Welwitschi.*

As is true of the plants from Portugal and South Africa, the material of Batters from the coast of Dorset and the Channel Islands occurred (according to Newton, 1931, p. 243) on *Ralfsia*, and the ones from France and Spain reported upon by Hamel (1924, pp. 13–14, fig. II, 3) likewise occurred on *Ralfsia.* The plants from South Africa like those from Europe are attached by a basal rhizoid which penetrates the tissue of the host.

The only other records of *Erythrotrichia Welwitschi* are those of Smith (1944, p. 163, pl. 36, figs. 1–2) and Doty (1947, p. 159) who reported it from the Pacific coast of North America. According to Doty, the erect filaments in his plants arose from a monostromatic base and the same appears to be true of the material reported upon by Smith. It is not inconceivable that the plants from the Pacific represent a different species.

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*It is to be noted that the binomial *Erythrotrichia ciliaris* is invariably credited to Batters (1900, p. 374). The combination was first made, however, by Thuret (in Le Jolis 1863) on the basis of a plant (*Porphyra Boryana* Montagne, *in* Durieu de Maisonneuve 1846, p. 150) which he misidentified with *Bangia ciliaris* Carmichael. Although Thuret had the wrong plant in hand when he made the transfer, he should, in accordance with ART. 54 of the Rules, be credited with the authorship of *E. ciliaris.*

Chaetangium erinaceum (Turn.) Papenfuss, comb. nov.

Fucus erinaceus Turner, Fuci 1: 55, 56, pl. 26, 1808.

Chaetangium ornatum auct. Non *Fucus ornatus* Linnaeus, Mant. pl., ed. 2: 312, 1771=*Suhria vittata* (L.) J. Agardh ex Endlicher, Gen. pl., suppl. 3: 41, 1843.

This species is well known by the name *Chaetangium ornatum*, but unfortunately this binomial cannot be maintained because the type of the name-bringing synonym, *Fucus ornatus* Linnaeus (1771), is representative of *F. vittatus* Linnaeus (1767, p. 718), which is the basinym of *Suhria vittata* (L.) J. Ag. ex Endl.

Herb. Linnaeus contains three sheets of specimens of the *Fucus vittatus-F. ornatus* complex, numbers 1274–79, 1274–80, and 1274–81 of Savage's catalogue. I have examined these specimens. Sheet 1274–79 contains three specimens and is marked "vittatus" in the hand of Linnaeus. This is the type sheet of *F. vittatus* (=*Suhria vittata*). It is pinned to sheet 1274–80, as it was in Turner's time (1808, p. 144, footnote†). Sheet 1274–80 contains two specimens and is marked "Fucus ornatus" in the hand of Linnaeus. This is the type sheet of *F. ornatus*. Both specimens are of *F. vittatus*. Sheet 1274–81 contains two specimens and is marked "vittatus" in the hand of Linnaeus fil. One of the specimens is *Suhria vittata* and the other is *Chaetangium erinaceum*.

The fact that the type sheets of *Fucus vittatus* and *F. ornatus* are pinned together suggests that Linnaeus himself may have realized that these binomials were based on the same species, and it is obvious that Reichard (1780, p. 580) was aware of the close relationship between these two species when he reduced *F. ornatus* to a variety under *F. vittatus*. Later, following an examination of the material of Linnaeus, Turner (1808, pp. 144, 56) pointed out that Linnaeus had founded *F. ornatus* on plants of *F. vittatus*; but botanists in general have ignored Turner's remarks and have continued to accept the specific name *ornatum* for a species of *Chaetangium* from South Africa. Rudolphi (1831, p. 175) and Suhr (1834, p. 370) are the only authors who have employed the epithet *erinaceus* of Turner (both as *Sphaerococcus erinaceus*) for this plant.

Gelidium micropterum Kütz.

Gelidium micropterum Kützing, Tab. phyc. 18: 21, pl. 59, figs. c-g, 1868.

Gelidium corneum sensu: Harvey, Gen. So. Afr. pl.: 399, 1838; Barton, Jour. Bot. 31: 172, 1893 (as to the Harvey material from Sea Point only). Non *Gelidium corneum* (Huds.) Lamouroux, Ann. Mus. Hist. Nat. [Paris] 20: 129, 1813.

This species was described and illustrated by Kützing from material from South Africa. The type (which I have seen) was communicated by

Hohenacker, but the exact locality in South Africa where the specimens were obtained is not known. In 1876, J. Agardh reduced *Gelidium micropterum*, with a query, to the synonymy of *G. cartilagineum*, where it remained until 1938 when Borgesen revived the name for a plant from India.

Gelidium micropterum bears some resemblance to *G. pristoides* and might be confused with this species, but hardly with *G. cartilagineum*, from which it differs markedly. As will be apparent from Kützing's figures of *G. micropterum* (Tab. Phyc. 18, pl. 59) and *G. pristoides* (*op. cit.*, pl. 65), the former is smaller and its flattened branches lack the marginal serrations characteristic of the latter species.

In general, *Gelidium micropterum* is an inhabitant of the colder, west coast waters of South Africa and serves as the counterpart of *G. pristoides*, which attains its optimum development along the south coast. On the basis of material collected by Professor T. A. Stephenson and his associates, *G. micropterum* is known from various west coast localities including Buffels River (south of Port Nolloth) in the north. Along the south-western part of the Cape Peninsula and in False Bay, *G. micropterum* and *G. pristoides* overlap in their distribution. According to Stephenson (1944, p. 330) *G. micropterum* extends eastward along the south coast as far as Cape Agulhas. Although the occurrence of this species at Cape Agulhas, or perhaps even east of it, appears entirely possible, I have not had an opportunity of verifying its presence at localities east of False Bay.

In addition to the plants from India which Børgesen (1938, p. 121) assigned to *Gelidium micropterum*, he (1943, p. 7) has referred to it specimens from Mauritius and Reunion. In consideration of the fact that South Africa is the type locality of this species and that it is here essentially an inhabitant of the cold west coast waters, it seems highly probable that the plants dealt with by Borgesen belong to a different species.

Gelidium spinulosum (Ag.) J. Ag.

Gelidium spinulosum (Ag.) J. Agardh, Sp. alg. 2 (2^1): 475, 1852; DeToni, Syll. alg. 4 (1): 155, 1897.

J. Agardh gave South Africa as the source of one of his specimens of *Gelidium spinulosum*, and since that time South Africa has always been included in the list of known localities for this species. J. Agardh's record is based on a small fragment which lies loose in a folded paper in Herb. Agardh. It is labelled, "C. B. Sp. Sph. asper?" Examination of this specimen has revealed that it actually is representative of *G. spinulosum*. Since this species is at home along the Atlantic coasts of Spain and Morocco and in the Canary and Azores Islands, and since extensive collecting in recent years has not revealed its occurrence in South Africa, it seems safe to conclude that J. Agardh's record was the result of a transposition of labels.

Gelidiella acerosa (Forssk.) Feldm. et Hamel.

Gelidiella acerosa (Forssk.) Feldmann et Hamel, Rev. Gen. Bot. 46: 533, 1934.

Gelidium rigidum (Vahl) Greville, Alg. brit.: lvii, 1830; Barton, Jour. Bot. 31: 172, 1893.

The majority of South African specimens which various authors have assigned to *Gelidium rigidum* (or *Gelidiella acerosa*, as the species is now known) have been found to belong to *Gelidium Amansii* (Lamour.) Lamouroux (1813). The only exception to this, to my knowledge, is the specimen upon which the record of Barton is based. With a query, Barton (1893, p. 172) referred to *Gelidium rigidum* a specimen in the herbarium of the British Museum and commented: "This specimen is too fragmentary to identify with accuracy." The specimen is labelled "Sphaerococcus spinosus Ag. C. B. Spei," in a hand unknown to me, and "Gelidium rigidum Grev." in Barton's hand. Examination of the specimen has revealed that it actually is representative of *Gelidiella acerosa*. Despite the extensive collecting of recent years no plants of this species have been obtained in South Africa. It seems highly probable, therefore, that the specimen referred to by Barton was not collected in South Africa, and for the present it seems best to exclude *G. acerosa* from this flora.

Peyssonelia capensis Mont.

Peyssonelia capensis Montagne, Ann. Sci. Nat., sér. 3, Bot. 7: 177, 1847.

Peyssonelia major Kützing, Sp. alg.: 693, 1849; Tab. phyc. 19: 31, pl. 88, 1869.

The identity of *Peyssonelia capensis* has always been a matter of doubt. Examination of the type (in Herb. Montagne in Mus. Natl. Hist. Nat., Paris), which was collected by Drège at Port Natal, has revealed that it is conspecific with *P. major*, which was based on a specimen collected at Port Natal by Gueinzius. This remarkable plant is common in certain areas along the eastern coast of South Africa and has become comparatively well known in recent times by the name *P. major*.

Gracilaria Beckeri (J. Ag.) Papenfuss, comb. nov.

Tyleiophora Beckeri J. Agardh, Till. alg. syst. (afd. 6): 36, 1890.

Tylotus Beckeri (J. Ag.) Kylin, Florideenordn. Gigartinales: 60, fig. 17 a-b, pl. 22, fig. 55, 1932.

On the basis of material from South Africa, J. Agardh established the new genus and species *Tyleiophora Beckeri*. *Tyleiophora* agrees in vegetative structure with *Gracilaria* Greville (1830) and the monotypic *Tylotus* J. Agardh (1876). It differs, however, from *Gracilaria* in having its sporangia aggregated in elongated nemathecial sori, instead of scattered over the surface of the thallus, and from *Tylotus* in having cruciately divided instead of zonately divided sporangia.

In studying these genera, Kylin (1932) could not find sporangia in J. Agardh's material of *Tylotus obtusatus* (Sonder) J. Ag., the type of the genus, and concluded that J. Agardh had made an error in reporting zonately divided sporangia in this species. Since *Tylotus* in other respects agreed with *Tyleiophora*, Kylin united these two genera under the name *Tylotus*, which had priority, made the combination *Tylotus Beckeri*, and placed *Tylotus* in the family Gracilariaceae, which he characterized as having cruciately divided sporangia. As a result of Kylin's work our concept of *Tylotus* thus underwent a marked change.

In connection with his study of the Gracilariaceae of the north-eastern Pacific, Dawson (1949) examined authentic material of *Tylotus obtusatus* from Western Australia (which he kindly allowed me to see) and found that J. Agardh had been correct in describing the sporangia of this species as zonately divided. In the light of Dawson's observations, it would thus be wrong to unite *Tyleiophora* with *Tylotus*, which, as Dawson pointed out, has to be excluded from the Gracilariaceae. Dawson (*op. cit.*, p. 5) found, furthermore, that: "The genus *Gracilaria*, . . ., contains numerous flat species showing the complete series of gradations from tetrasporangia borne in a completely unmodified cortex to tetrasporangia borne in well-developed nemathecia."

Since *Tyleiophora* as conceived by J. Agardh differs from *Gracilaria* only in having its sporangia in nemathecia and since Dawson has found that in some species of *Gracilaria* the sporangia are localized in nemathecia, it becomes clear that *Tyleiophora* cannot be maintained. The genus is congeneric with *Gracilaria* rather than the related *Gracilariopsis* Dawson (1949) because, as in *Gracilaria*, the gonimoblast of *Tyleiophora Beckeri* produces nutritive filaments which establish connections with cells in the pericarp (*cf.*, Kylin 1932, fig. 17*a*). Such filaments are not produced in *Gracilariopsis*.

Gracilaria capensis Schm. ex Mazza.

Gracilaria capensis Schmitz ex Mazza, Nuova Not. 18: 134, No. 166, 1907.

Tylotus capensis (Schm. ex Mazza) Papenfuss, Bot. Not. 1940: 220, fig. 14, 1940.

Gracilaria denticulata Schm. ex Mazza.

Gracilaria denticulata Schmitz ex Mazza, Nuova Not. 18: 138, No. 172, 1907.

Tylotus denticulatus (Schm. ex Mazza) Papenfuss, Bot. Not. 1940: 221, fig. 15, 1940.

In consideration of the statements made under *Gracilaria Beckeri*, it becomes necessary to return the preceding two species to *Gracilaria*. In characteristic fashion, the gonimoblast in both species produces nutritive filaments which fuse with cells in the pericarp.

It may be noted that Weber-van Bosse (1928), Yamada (1938), and Borgesen (1943) have reported material from Indonesia, the Ryukyu Islands, and Mauritius, respectively, under the name *Gracilaria denticulata* (Kütz.) Schmitz, citing as the name-bringing synonym *Sphaerococcus denticulatus* Kützing (1869). The association by Weber-van Bosse of *S. denticulatus* with *G. denticulata* Schmitz ex Mazza was erroneous for two reasons. First, Mazza published the South African plant as a new species, without reference to *S. denticulatus*. Second, *S. denticulatus* was obtained by Vieillard in New Caledonia, and to judge from Kützing's (1869, pl. 51, fig. e) illustration of its habit, it appears to represent a different species than *G. denticulata* Schmitz ex Mazza.

Whether the material of Weber-van Bosse, Yamada, and Borgesen is in all instances representative of *Sphaerococcus denticulatus* is not certain, but if this species of Kützing should prove to belong to *Gracilaria*, as seems likely from the observations of Weber-van Bosse, it will have to receive another specific name.

Callithamnion gracile Hook. f. et Harv.

Callithamnion gracile Hooker f. et Harvey *in* Hooker, Fl. antarct. 1: 191, pl. 78, fig. 1, 1845.

Dickie (1876, p. 41) and Barton (1893, p. 114) assigned, with doubt, to *Callithamnion gracile* material which had been collected by Moseley in Simons Bay. An examination of this material (in Herb. Mus. Brit.) revealed bryozoan and other animal material, fragments of algae, and sand, but nothing which could be referred to *Callithamnion* or a related genus of algae. It seems best, therefore, to exclude *C. gracile* from the flora of South Africa. Thus far, the species apparently is known only from Campbell Island in the sub-Antarctic.

Ceramium planum Kütz.

Ceramium planum Kützing, Sp. alg.: 687, 1849; Tab. phyc. 13: 5, pl. 11, figs. c-d, 1863.

Ceramium cancellatum C. Agardh, Syst. alg.: 136, 1824; Sp. alg. 2 (1):

145, 1828. Non *Ceramium cancellatum* (L.) DeCandolle, Bull. Sci. Soc. Philom. Paris 3 (94): 264, 1804–1805*.

Pteroceras cancellatum (C. Ag.) Kützing, Sp. alg.: 690, 1849; Tab. phyc. 13: 8, pl. 22, figs. a-b, 1863.

Pteroceras flexuosum Kützing, Sp. alg.: 690, 1849; Tab. phyc. 13: 8, pl. 22, figs. c-e, 1863.

Ceramium flexuosum (Kütz.) Grunow, Alg. Novara: 64, 1867. Non *Ceramium flexuosum* C. Agardh, Syst. alg.: 141, 1824=*Pleonosporium flexuosum* (C. Ag.) Bornet, Alg. Schousboe: 167, 1892.

On the basis of an examination of a photograph and a fragment of the type of *Ceramium flexuosum* (Kütz.) Grunow and a specimen of *C. cancellatum* C. Ag. of Tyson's distribution (No. 85) of South African marine algae, Mazoyer (1938, p. 16) concluded that these two South African taxa were nothing but forms of the same species. An examination of the type specimens of both *C. cancellatum* C. Ag. and *C. flexuosum* (Kütz.) Grunow has convinced me that the observations of Mazoyer were correct. Furthermore, a study of the type of *C. planum* Kützing has shown that this taxon is also representative of the same species. Since *C. cancellatum* C. Agardh (1824) and *C. flexuosum* (Kütz.) Grunow (1867) are later homonyms, the correct name for this species is *C. planum* Kützing.

Ceramium obsoletum C. Ag.

Ceramium obsoletum C. Agardh, Sp. alg. 2 (1): 145, 1828; Kützing, Tab. phyc. 13: 4, pl. 10, figs. a-d, 1863.

Ceramium furcellatum Kützing, Sp. alg.: 687, 1849; Tab. phyc. 13: 4, pl. 11, figs. a-b, 1863; J. Agardh, Sp. alg. 2 (1): 142, 1851. Non *Ceramium furcellatum* (L.) Wiggers, Prim. fl. hols.: 91, 1780=*Furcellaria fastigiata* (L.) Lamouroux, Ann. Mus. Hist. Nat. [Paris] 20: 46, 1813.

Examination of Kützing's type material of *Ceramium furcellatum* has shown that this South African taxon, which has been known only from the description and illustrations of Kützing, is conspecific with *C. obsoletum*.

*If the nomenclatural history of *Ceramium cancellatum* DC. is traced it is found that this name, as to type, applies to a species of the bryozoan genus *Vesicularia*. Although DeCandolle appears to have had *Halurus equisetifolius* (Lightf.) Kütz. in hand when he made the combination *Ceramium cancellatum*, he gave *Conferva cancellata* Linnaeus (1753) as the basinym of his binomial (*cf.* Roth 1800, pp. 230, 231; C. Agardh 1828, p. 134; Kützing 1849, p. 662; J. Agardh 1851, p. 91). Examination of the second part of the "Species plantarum" (p. 1165) shows that Linnaeus based *Conferva cancellata* upon the *Conferva marina cancellata* of Dillenius (1741, p. 24, pl. 4, fig. 22). In the absence of a specimen under the name *Conferva cancellata* in the Linnean herbarium (*cf.* Savage 1945), this species must be typified with the specimen in the Dillenian herbarium. According to Turner (1804, p. 106) and Druce and Vines (1907, p. 189) this specimen is representative of *Sertularia spinosa* (=*Vesicularia spinosa*). Even though *Ceramium cancellatum* (L.) DeCandolle (1804–1805) is based on an animal, this name, according to Art. 6 of the Rules, retains its status in botanical nomenclature, and hence must be treated as an earlier homonym of *C. cancellatum* C. Agardh (1824).

Reinboldiella Poeppigiana (Grun.) Feldm. et Mazoy.

Reinboldiella Poeppigiana (Grun.) Feldmann et Mazoyer, Bull. Soc. Hist. Nat. Afr. Nord. 28: 213, figs. 1–4, 1937.

Ceramium Poeppigianum Grunow, Alg. Novara: 64, pl. 8, figs. 2a-d, 1867; Barton, Jour. Bot. 34: 195, 1896.

Ceramium prorepens sensu Barton, loc. cit. Non *C. prorepens* Grunow, Alg. Novara: 64, pl. 8, figs. 1a-d, 1867.

An examination of the material upon which Barton established the occurrence of *Ceramium prorepens* in South Africa has shown that her records were based upon *Reinboldiella Poeppigiana. Ceramium prorepens* is accordingly to be excluded from the flora of South Africa.

Taenioma nanum (Kütz.) Papenfuss, comb. nov.

Polysiphonia nana Kützing, Sp. alg.: 879, 1849; Tab. phyc. 13: 10, pl. 29, figs. e-f, 1863. Non *Polysiphonia nana* Harvey *in* Hooker, Fl. nov.-zel. 2: 228, 1855.

Taenioma macrourum Thuret *in* Bornet et Thuret, Notes algol., fasc. 1: 69, pl. 25, 1876.

In a paper on the genus *Taenioma* (Papenfuss 1944a, p. 205) I remarked: "Bornet . . . when uniting *T. perpusillum* and *T. macrourum* listed as a synonym the South African species described by Kützing . . . in 1863 as *Polysiphonia nana*, while Falkenberg . . . gave the latter as a synonym of *T. macrourum.* Kützing figured *P. nana* as having some branches ending in a large inflated apical cell and others ending in two hairs. If *P. nana* were a species of *Taenioma*, it would thus be logical to consider it as representative of *T. macrourum*; and since *nana* is the older specific name it would have priority over *macrourum.* The writer has not had the opportunity of examining Kützing's material nor has he been able to identify with certainty a South African plant with Kützing's species. Judging from Kützing's description and figure, however, there is little reason for believing that *Polysiphonia nana* is representative of the genus *Taenioma.* It seems more likely that the species is a rhodomelaceous alga. The segments show four parallel, vertically elongated, cells of the same length, which suggest pericentral cells as seen in surface view."

I have now had an opportunity of examining the type material of *Polysiphonia nana* Kützing. This material consists of two small mounts—one on mica and the other on paper. The specimens represent the same species and occur intermingled with a cladophoraceous green alga. In the light of Kützing's illustration, it was indeed a surprise to find that his species actually was conspecific with *Taenioma macrourum* Thuret. As is characteristic of *T. macrourum,* the determinate branchlets end in two hairs (cf., Papenfuss 1944*a*, p. 204), and as is true of both the known species of *Taenioma* the determinate branches are flat, consisting of five cells in width, with each of the lateral pericentral cells flanked at the margin by two cells, whose combined length equals that of a pericentral cell. The indeterminate branches are cylindrical, with each of the segments consisting of a central and four pericentral cells. My erroneous conclusion that *Polysiphonia nana* Kützing was representative of a rhodomelaceous alga was owing to Kützing's inaccurate representation of the anatomical structure of his plant. He not only failed to observe that the branches were of two kinds but failed to notice that in some of the branches (the flat determinate ones) the cells along the margin were only half as long as the other cells of the thallus. This latter character is especially important for it furnishes a clear-cut means of separating a delesseriaceous alga with narrow branches from a member of the Rhodomelaceae (cf., Papenfuss 1944*a*, p. 201). Furthermore, Kützing illustrated the branches of the thallus as having four pericentral cells as seen in surface view, whereas only three pericentral cells are actually to be seen in surface view.

In contrast to the specimens of *Taenioma purpusillum* from Hawaii and South Africa which were studied by me in 1944. Kützing's examples of *T. macrourum* show determinate branches with terminal hairs which are more or less inflated along most of their length; and in many branches the greater portion of a hair is shed, leaving a basal stub which somewhat resembles an apical cell. In some instances the development of one of the apical hairs is retarded and the impression is gained that a branch is terminated by only one hair instead of two as is characteristic in *T. macrourum*. However, in the majority of determinate branches of this kind, a rudimentary second hair can be observed and in no instance could it be established with certainty that only one hair had been formed as one might be led to believe from Kützing's figure.

It is to be noted that Kützing in 1863, when he redescribed *Polysiphonia nana* as a new species, had completely overlooked the fact that he had already described the species under this name in 1849 in the "Addenda et Corrigenda" of his "Species algarum." Along with all previous authors, I had also for a long time failed to note this fact and had been under the impression that even if *Polysiphonia nana* Kütz. were conspecific with *Taenioma macrourum* Thuret (*in* Bornet and Thuret 1876) the former epithet would not have priority over the latter, as I believed it had in 1944, because of the existence of the seemingly illegitimatizing homonym *Polysiphonia nana* Harvey (*in* Hooker 1855). The information now at hand, however, makes it necessary to supplant the name *Taenioma macrourum* Thur. with *T. nanum* (Kütz.) Papenf.

Laing (1901, 1926) does not list *Polysiphonia nana* Harvey, which is based on a plant from New Zealand, but if this is an autonomous species (cf. DeToni 1903, p. 888), it will have to receive a new name.

Finally, it is necessary to point out that *Taenioma nanum* should be excluded from the flora of South Africa, for Kützing (1863) made an error in giving South Africa as the source of his material of *Polysiphonia nana*. In his hand, the label accompanying his specimens bears the data: "Polysiphonia nana Kg. Tab. phyc. xiii. 29. Neapel. Naegeli" and the paper on which the one specimen is pressed bears the number "519." Furthermore, in 1849 he had cited as the source of his material: "In sinu neapolitano: cl. Naegeli (519)." *Taenioma purpusillum* is therefore, as far as known, the only representative of this genus in South Africa.

Acrosorium uncinatum (Turn.) Kylin.

Acrosorium uncinatum (Turn.) Kylin, Lunds Univ. Årsskr. N. F. Avd. 2, 20 (6): 78, fig. 61, 1924.

Fucus laceratus var. ζ *uncinatus* Turner, Fuci 1: 151, pl. 68, figs. c-d, 1808.

Nitophyllum uncinatum (Turn.) J. Agardh, Sp. alg. 2 (2^2): 654, 1852.

Following the precendent set by Kylin (1924) in his monograph of the Delesseriaceae, this widely distributed species (which has previously been reported from South Africa) is invariably credited to J. Agardh (1852*b*), who established the binomial *Nitophyllum uncinatum*. J. Agardh himself, however, cited *Fucus laceratus* var. ζ *uncinatus* Turner as the basinym of this binomial. I have seen Turner's type (at Kew) and found it to be representative of *Acrosorium uncinatum* as generally understood. The type was collected by Miss Hill in 1807 at Tenby (Pembroke) in Wales.

Neurymenia fraxinifolia (Mert. ex Turn.) J. Ag.

Neurymenia fraxinifolia (Mert. ex Turn.) J. Agardh, Sp. alg. 2 (3^2): 1135 1863.

Fucus fraxinifolia Mertens ex Turner, Fuci 3: 140, pl. 193, 1811.

This species is here reported for the first time from South Africa. Tetrasporangial plants, with the blades measuring up to 1 cm. in width were collected by Pocock and Papenfuss at Perriers Rocks in the St. Lucia Bay area in July, 1938. I have seen the type of *Neurymenia fraxinifolia* in the herbarium of the University of Copenhagen. This specimen was obtained in the East Indies. *Neurymenia* is a monotypic genus which has an extensive distribution in the Indian and Pacific oceans.

Laurencia Forsteri (Mert. ex Turn.) Grev.

Laurencia Forsteri (Mert. ex Turn.) Greville, Alg. brit.: lii, 1830.

The only record of the occurrence in South Africa of this Australian species is that of Barton (1893, p. 174). This record is based on a single specimen (in Herb. Mus. Brit.) which is labelled "Laurencia Forsteri" in Harvey's hand. The locality is given as "Cape of Good Hope" but the writing is not that of Harvey. The specimen apparently is representative of *L. Forsteri* but it seems reasonably certain that its source was Australia or Tasmania rather than South Africa. No South African specimens named *L. Forsteri* occur in Harvey's herbarium, nor did Harvey in his writings credit South Africa with this species. Furthermore, extensive collecting in recent years has failed to reveal the occurrence of *L. Forsteri* in South Africa.

Laurencia glomerata Kütz.

Laurencia glomerata Kützing, Sp. alg.: 857, 1849; Tab. phyc. 15: 26, pl. 73, figs. a-c, 1865; Kylin, Lunds Univ. Årsskr. N. F. Avd. 2, 34 (8): 24, pl. 8, fig. 22, 1938.

Laurencia virgata (C. Ag.) J. Agardh, Sp. alg. 2 (3^1): 752, 1852; Sp. alg. 3 (1): 653, 1876 (excl. syn. *L. cymosa major* Kütz. and extra-South African records); Yamada, Univ. Calif. Publ. Bot. 16 (7): 208, pl. 8, 1931.

Chondria obtusa ζ virgata C. Agardh, Sp. alg. 1 (2): 343, 1822.

J. Agardh (1852*c*, p. 767) reduced *Laurencia glomerata* to the synonymy of *L. flexuosa*, both of which species were described by Kützing (1849) from plants from South Africa, and at the same time (p. 753) erected *L. glomerata* Suhr ex J. Agardh for a plant from the Caribbean.

Following the reduction of *Laurencia glomerata* Kütz. by J. Agardh, this name either was given, as by DeToni (1903), in the synonymy of both *L. flexuosa* (as to Kützing's original description of *L. glomerata*) and *L. virgata* (as to Kützing's illustration of *L. glomerata* in Tab. phyc. 15, pl. 73) or it was omitted, as by Yamada (1931, pp. 208, 242), from the synonymy of both.

Although Kützing's (1865) illustrations of *Laurencia glomerata* Kütz. (pl. 73) and *L. flexuosa* (pl. 68) clearly show that these two entities are not conspecific, and although J. Agardh's (1852*c*) diagnosis of *L. virgata* (based upon a plant from South Africa) as well as Yamada's (1931, pl. 8, fig. a) illustration of a specimen, in the general herbarium at Paris, which he regarded as an isotype of *L. virgata*, suggest that this entity is conspecific with *L. glomerata* Kütz., the relationship between these two taxa remained uncertain.

This uncertainty was increased when Kylin in 1938 (p. 25) implied that *Laurencia virgata* represented a species distinct from *L. glomerata* Kütz.

Obviously this question could not be settled until the types of both *Laurencia virgata* and *L. glomerata* Kütz. had been examined. This I have been able to do, and in my opinion these names apply to one and the same species.

Laurencia laxa (Turn.) Gaill.

Laurencia laxa (Turn.) Gaillon, Dict. Sci. Nat. [Levrault] 53: 363, 1828; Greville, Alg. brit.: lii, 1830; Endlicher, Gen. pl., suppl. 3: 43, 1843; Harvey, Ner. austr.: 83, 1847; J. Agardh, Sp. alg. 2 (3^1): 770, 1852; Sp. alg. 3 (1): 662, 1876; Barton, Jour. Bot. 31: 174, 1893 (pro parte).

Fucus laxus Turner, Fuci 4: 14, 15, pl. 203, 1819.

Chondria laxa (Turn.) C. Agardh, Sp. alg. 1 (2): 340, 1822; Syst. alg.: 202, 1824.

Laurencia laxa was described and illustrated by Turner (1819, as *Fucus laxus*) on the basis of a specimen, presumably from South Africa, which he received from Robert Brown. Nothing agreeing with *L. laxa* has since been found in South Africa and all subsequent references to this species are based on Turner's account.

In 1838 in his "Genera of South African Plants," Harvey remarked that *Laurencia laxa* was peculiar to the South African coasts and wrote (p. 401): "I have been so fortunate as to find this last [*L. laxa*] bearing fructification (urceoli) which was unknown to Turner at the time his excellent figure and description were published." However, this observation of Harvey applied to *Chondria capensis* (Harv.) Falk., which he at first confused with *L. laxa*, as is shown by his assigning the latter name to specimens of *C. capensis* (to be found in his herbarium at Trinity College and in the Agardhian Herbarium) and by the statement in his "Nereis australis" (1847, p. 86) that *Laurencia* (=*Chondria*) *capensis* was: "A very distinct species, although I formerly confused it with *L*; *laxa*, a plant I have never seen, . . ." On page 83 of the same work Harvey remarked that *L. laxa* was known to botanists only by the figure and description of Turner.

Despite Harvey's comments of 1847, the confusion of *Laurencia laxa* with *Chondria capensis* persisted to a certain extent, and in DeToni's "Sylloge algarum" (1903, p. 830) *Fucus laxus* and *Chondria laxa* are given as doubtful synonyms of *Chondria capensis*.

Examination of the type of *Laurencia laxa* (in Herb. Mus. Brit.) has convinced me that it is not representative of any of the South African species of *Laurencia*. The source of the specimen probably was Australia, where Robert Brown collected many of the species that were published by Turner.

Laurencia natalensis Kylin.

Laurencia natalensis Kylin, Lunds Univ. Årsskr. N. F. Avd, 34 (8): 24, pl. 8, fig. 21, 1938.

The records of the occurrence in South Africa of *Laurencia hybrida* (DC.) Lenorm. by Barton (1893, p. 174) and Delf and Michell (1921, p. 113) apply to *L. natalensis*. *Laurencia hybrida* is a European species which does not occur in South Africa.

Laurencia distichophylla J. Ag.

Laurencia distichophylla J. Agardh, Sp. alg. 2 (3^1): 762, 1852; Sp. alg. 3 (1): 656, 1876; Alg. nov.-zel. mar.: 26, 1877; Harvey in Hooker, Fl. nov.-zel. 2: 234, 1855; DeToni, Syll. alg. 4 (3): 800, 1903; 6: 373, 1924; Yamada, Univ. Calif. Publ. Bot. 16 (7): 235, 1931.

This species was established by J. Agardh (1852c) upon material in the herbarium of C. Agardh which is marked: "an e Cap. b. Spei (Hb. Ag.)." J. Agardh gave as the habitat of this species, "Hab. in oceano australi?" and thought that the material may have come from South Africa or from the Pacific.

In subsequent accounts of this species, South Africa has usually been given as one of its localities, sometimes with a query (J. Agardh 1876; Yamada 1931) and sometimes without (DeToni 1903, 1924; Yendo 1916; Laing 1926). Examination of the type specimen of *Laurencia distichophylla* (No. 37171 in Herb. Agardh) has revealed, however, that the plant is not representative of any of the South African species of *Laurencia*. The species is probably at home in New Zealand, whence it has been reported by Harvey (in Hooker 1855), J. Agardh (1877) and Laing (1901, 1926); and Lindauer has also distributed it from New Zealand as No. 71 of his "Algae Nova-Zelandicae Exsiccatae."

Yendo (1916) has assigned specimens from Japan to *Laurencia distichophylla*, but since neither Yamada (1931) nor Okamura (1936) accredit this species to the flora of Japan, it may be assumed that the record of Yendo was based on a misidentification. The disposition of *L. distichophylla* sensu Yendo is not apparent from the works of Yamada and Okamura.

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NOTES ON THE PROCESS OF FORMING CONTRACTILE ROOTS AND THE LOWERING OF THE FIRST BULBILS BY SEEDLINGS OF THE SOUTH AFRICAN OXALIS WHICH PRODUCE ENDOSPERMOUS SEEDS.

By Captain (S.) T. M. Salter, R.N. (Ret.)

I. A Short Summary of the Different Kinds of Contractile Roots in Oxalis Hitherto Recorded.

The first recorded examination of the behaviour of seedlings of Oxalis in forming their first bulb was published by Freidrich Hildebrand in 1884 in Lebensverhaltnisse der Oxalis-Arten, where he gave a description of this process in *Oxalis rubella* Jacq., a species which is synonymous with *O. hirta* L., or at least one of the many forms of that species. Later he observed similar action in seedlings of *O. Coppoleri* Tod., actually a form of *O. fabaefolia* Jacq. In both cases he was dealing with species which produce exendospermous seeds.

Hildebrand's observations were not very complete, but recently (1946) a very full account of the action of the slender contractile root in seedlings of *O. hirta* has been given by Miss A. J. Davey.(1)

The seeds of the South African species of Oxalis are of two distinct kinds: (*a*) the small brown rugose, slow-germinating seeds containing endosperm; and (*b*) the rather larger soft green, quick-germinating seeds which are entirely without endosperm, and it was with seeds of the latter kind that the observations referred to above were made. Approximately 119 have exendospermous seeds and 82 endospermous.(2)

The highly important function of the contractile root and its action in lowering bulbs and bulbils has been described by several authors. The process is roughly speaking of three kinds: (*a*) the contractile action, generally more or less vertically, of a comparatively thick watery root, such as has been best described by Thoday(3) and Davey(4) in the case of *O. incarnata*; (*b*) that of the slender thread-like contractile root in the seedling of *O. hirta* (Davey l.c.) and in the adult plant of *O. flava* L. (Davey l.c., pp. 250–251) and (*c*) the small contractile root which lowers the new bulb from aerial bulbils.(5)

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(1) On the Seedling of *Oxalis hirta* L. by A. J. Davey, Annals of Botany, Vol. X, No. 39 (1946) pp. 237–256. It should be noted that *O. hirta* is included in § K. Angustatae, sub-section Sessilifoliatae, and not in § J. Crassulae as stated in the footnote on p. 237.

(2) The Genus Oxalis in South Africa, by T. M. Salter, Supp. Vol. I to the Journal of South African Botany, 1944, p. 26.

(3) The Contractile Roots of Oxalis incarnata, by D. Thoday, Ann. of Bot. XL, No. 159, July 1926.

(4) On the Mechanism of Root-contraction in Oxalis incarnata L. by D. Thoday and A. J. Davey, Ann. of Bot., Vol. XLVI, No. 184 (1932), pp. 993–1005.

Although the contractile action which takes place in the formation of the first bulb in species producing exendospermous seeds has only been observed in detail in *O. hirta*, seedlings of 8 other species with similar seeds were raised with the object of ascertaining the nature of the first leaf.(6) From admittedly superficial observation of the development of these seedlings I do not think it is unreasonable to suppose that the first bulb formation is on similar lines in all the species producing these seeds.

II. THE FORMATION OF THE BULBS AND THE ACTION OF THE CONTRACTILE ROOT IN SEEDLINGS OF SOUTH AFRICAN OXALIS PRODUCING ENDOSPERMOUS SEEDS.

As far as I am aware no previous observations have been published as regards the bulb formation in seedlings of the South African Oxalis producing endospermous seeds. Here, although a contractile root comes into play, the process is different. It is true that the action has only been observed in two species, *O. tragopoda* Salter and *O. dentata* Jacq. and the observation has only been superficial.

In all the bulb-lowering processes referred to in Part I, where contractile roots come into play, there is always a compensating intercalary elongation of some organ of the plant, in the seedlings, the petiole and in the adult plants the underground stem, so that the aerial part of the plant is not affected. In this case, however, there is no intercalary elongation. Sessile bulbils, similar to those of the adult plants, but smaller, are formed on the underground stem and when the contractile root below them starts its action, the whole plant begins to sink gradually into the ground.

OXALIS TRAGOPODA Salter

Oxalis tragopoda of the § Cernuae, sub-section Stellatae, a species with endospermous seeds, fairly plentiful in the neighbourhood of Grahamstown, is being grown in the National Botanic Gardens at Kirstenbosch. In June 1949, seeds of this species, among others, were sent to the Department of Genetics at Cambridge University. I was surprised to hear that these seeds had produced flowering plants, under glass, by

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(5)Notes on the Aerial Bulbils in Oxalis laburnifolia Jacq.; Salter in Journal of S.A. Bot.. XIV (1948), pp. 15–18.

(6)The Genus Oxalis in S. Africa (1944), p. 28.

November, i.e. about 4½ months after gathering, for, judging from the process of bulb formation hitherto observed in species with exendospermous seeds, it seemed impossible that mature bulbs could have been formed in such a short time and it appeared unlikely that even the climatic change to the northern hemisphere could have had so much influence.

In June 1950, some seeds were collected and sown at Kirstenbosch, but only three germinated after 7 weeks. One seedling actually flowered in November before forming an adult bulb, producing, as it were, a second crop in one year. At this time it was observed that the plants were gradually sinking into the ground. When the underground system was examined in December it was found that a cluster of small bulbils had developed just below the leaves and that a fleshy contractile root, similar in appearance to those of the adult plants of *O. incarnata*, described by Thoday and Davey (see Part I) had been formed. This root was partially contracted and was in the process of drawing the whole plant into the ground taking the bulbils with it and so giving them a greater depth for normal growth in the next year, after the vegetative parts, which are annual in the South African Oxalis, had died away.

Oxalis dentata Jacq.

Seeds of *O. dentata* of the § Cernuae, sub-section Lividae, a common species in the Cape Peninsula, were collected early in June 1951, and sown at once in a glass-house at Kirstenbosch and they began to germinate freely after 13 days. The seedlings appeared to be much like adult plants, though smaller, except that many of them did not produce any aerial stem. They produced 2 to 5 normal leaves with petioles 2 to 4 cm. long. In October there was appreciably less of the petioles showing above ground and by the middle of November only about 1 cm., or less, was visible. At this stage one of the two tins containing them was opened up and they were found to be in the state shown in Fig. 1—AAA. The seeds had germinated more freely than had been expected and the numerous fibrous roots, often up to 10 cm. long, were so matted together that it was necessary to wash the plants out of the soil. The contractile roots, which appeared to be similar to those of *O. incarnata*, were not fully contracted. The plants had each produced 1—3 (commonly 2) sessile bulbils, similar to those of the adult plant, the largest about 1 cm. long, some on the short underground stem above the crown of the contractile root and some in the axils of the leaves, but they were never visible above ground. They were being drawn down into the soil with

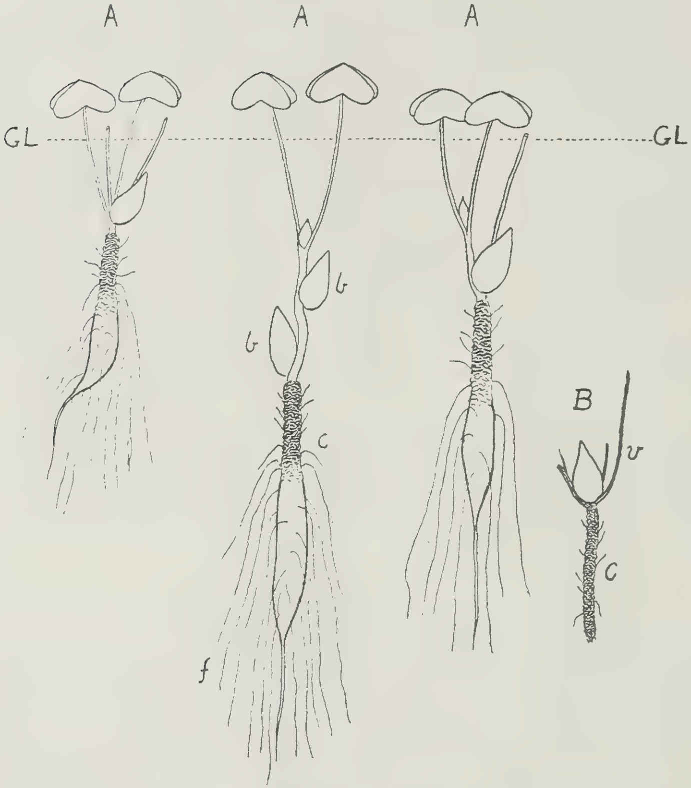

FIG. 1.—AAA. Seedlings of *Oxalis dentata* Jacq. five months after germination; G.L. ground level; b, bulbils; c, contractile root; f, fibrous roots (reduced in number and length). B, a bulbil at its final depth (4—7 cm.) 7½ months after germination, with (v) the dead remains of the vegetative parts and (c) completely exhausted contractile root. Approximately natural size.

the rest of the plant which dies away when its bulb-producing function is completed. By the middle of December all traces of the seedlings had disappeared underground. Late in January 1952, when it was estimated that the contractile process would be complete, the second tin was opened up. Unfortunately, owing to a change in the Gardens staff, the tin had been watered freely and this had probably hastened the decomposition of the contractile roots and vegetative parts which had broken away from the bulbils and were very difficult to find. The bulbils, which had scarcely increased in size, were found at varying depths, a few near the surface appeared to have broken away from the seedlings in their descent, but the majority were found at a depth of 4 to 7 cm. In several the completely exhausted contractile root, or at least part of it, was found still adhering and one (Fig. 1—B) was extracted with the bulbil and contractile root still attached to the dead remains of the vegetative parts.

Although the final stage would have been seen more clearly if the tin had been opened up earlier, the main object was to ascertain the size the bulbils had attained and the depth to which they descend in the first year.

In the adult stage the bulbs of *O. dentata* are usually found at a depth of 8 to 12 cm. and this species has the peculiar and perhaps unique habit of developing a long *horizontal* contractile root which draws the new bulb sometimes as much as 1 ft. from the parent plant and adult bulbs are consequently always found lying on their sides, as shown on Plate II (i), opposite page 82 in The Genus Oxalis in South Africa. The contractile action in the case of the seedlings is, of course, vertical.

The bulbils as finally produced by the seedlings, though now brown and showing the characteristic longitudinal grooves of the species, are obviously immature and it seems probable that a second and possibly a third annual lowering process will be necessary before adult flowering bulbs are developed. The bulbils formed by seedlings of this species raised at Cambridge showed no sign of flowering in the second year.

CONCLUSIONS

The bulb formation in *O. tragopoda* and *O. dentata* described above suggests that a similar process comes into play in all the species bearing endospermous seeds. Unfortunately the seeds of many of these species, particularly those with solitary flowers, are by no means easy to collect and many of them do not germinate freely. Seeds of *O. pes caprae* L., *O. purpurata* L. and *O. lanata* L.f., sent to Cambridge in 1949, failed to germinate at all.

I have, however, placed the foregoing facts on record in the hope that some younger observer, who may have better facilities than myself, may be able to inquire more deeply into the subject.

It would be advantageous to sow the seeds in as many receptacles as possible in order to allow of at least monthly inspection of the underground development. A friable soil, mixed with plenty of sand, would probably be found most suitable and the admixture of any humus or sifted compost should be avoided.

In all probability the species known to have seeds with a thin layer of endosperm, and in which the embryo is green, would be the best for trial. Of these, *O. Bowiei* Lindl. and *O. imbricata* E. & Z. suggest themselves, since they have been proved to germinate quickly and, although they do not occur in the Cape Peninsula, are by no means rare.

ACKNOWLEDGMENTS

I am indebted to the Director of the National Botanic Gardens for the accommodation of my plants in the Nursery at Kirstenbosch and to Mr. J. Templeton of the gardening staff for sowing and timing the germination of the seeds.

I would like, also, to record my thanks to Mrs. Vivian C. Fyfe, of the Department of Genetics at Cambridge University, for the fully detailed information sent to me, over a period of years, with regard to the progress, in the Northern Hemisphere, of the seeds and bulbs sent over. It was this information that led directly to the experimental observations recorded here.

BOOK REVIEWS.

The Families of Dicotyledons. By A. Gundersen. xviii+238, numerous line-drawings. Waltham, Mass.: Chronica Botanica Co. London, W.C.2: Wm. Dawson and Sons, Ltd. 1951. $4·75.

This compact book reflects the recent great growth of interest in the morphology and relationships of the Flowering Plants. It makes no startling changes in existing systems, but suggests numerous cross-connexions between families and points out lines of research work which may lead to a better understanding of the endlessly complicated systematic meshwork of the Dicotyledons. There are short introductory chapters (of very unequal value) by other authors on the various lines of work which converge on the main evolutionary problem—anatomy, fossil history, cytology, plant geography, etc.—but the main part of the work consists of condensed summaries of the 240 families distinguished by the author. This number is rather less than that of Hutchinson (264) but is much greater than those of Bentham and Hooker and Engler (200); largely because of recently described and discriminated families from the Far East and Pacific areas, whose validity can only be tested by further exploration and study. This variation in outlook as to number and scope of families compels a negative answer to the author who, for practical convenience "wonders whether the time is ripe or not for an attempt to prepare a widely acceptable standardized list of the families of dicotyledons (and other groups)".

Gundersen's account of each family is very brief but it contains the salient morphological features together with a valuable collection of references to recent studies, including chromosome numbers, anatomy, etc., bearing on the family's relationships; abbreviations being used freely. The majority of the families are illustrated by bold drawings of floral structure, often including developmental stages, contributed by Miss M. A. Purdy, and these form a most instructive part of the book, though the question of scale is often not at all clear.

As a teaching manual, as a supplement to other synopses of the dicotyledonous families, and as suggesting further investigations, this book will be welcome. The author, who was for 32 years on the staff of the Brooklyn Botanic Garden, at first in the herbarium, later as Curator of Plants, is to be congratulated on a very useful and thought-provoking addition to the systematics of the Flowering Plants.

R. H. Compton.

MANUAL OF PHYCOLOGY. Edited by Gilbert M. Smith. Chronica Botanica Co., Waltham, Mass., U.S.A. London, W.C.2: Wm. Dawson and Sons, Ltd. 1950. $7·50.

This volume is a most welcome addition to Phycological literature. In less than 400 pages the book covers a much more extensive field than is covered by most books on algae. Each chapter is written by an authority on that aspect of the subject. The only serious omission relates to the economic aspect but it is hoped that an entire volume will be published later dealing with this. Even with this omission it is inevitable that the available space will not allow full justice for all the numerous topics considered. Parts of the book certainly have the character of skeleton outlines and guides to the literature; more detail would often be welcome. The limited size of the volume may also account for the somewhat inadequate illustrations.

In order to avoid further delay in publication references subsequent to 1948 are not included.

Following an historical introduction (Prescott), there is an interesting and valuable discussion on classification (Smith). This chapter deals with the inclusion of flagellate forms among the algae and the consequent increase in the number of recognized algal groups; the taxonomic status of the groups delimited is also considered. The seven chapters which follow deal with the various algal groups and as this occupies less than half of the volume it is not surprising that certain sections are very condensed. This is evident in the chapter on Chlorophyta (Iyengar) which contains, however, a less condensed and an instructive summary of the types of life history occurring among the green algae.

The taxonomic approach outlined in the second chapter is amplified and applied in the subsequent accounts of the major algal groups. This is seen in the comments on differences in nutritional status of members of the Euglenophyta (Jahn), Chrysophyta (Fritsch) and Pyrrophyta (Graham) and in the descriptions of transitions from flagellate to algal organization seen in the predominantly flagellate groups. The chapters dealing with the Divisions of Algae also contain comments relating to the taxonomic subdivision of the major groups. Thus Papenfuss in the chapter on Phaeophyta discusses the morphologically dissimilar generations of *Cutleria* in relation to the subdivision of the brown algae into Isogeneratae, Heterogeneratae and Cyclosporeae. He also calls attention to the uncertainty regarding the systematic position of the plants included in the Chordariales due to our limited knowledge of the order.

The remaining part of the book deals with a considerable range of subjects: fossil algae (Johnson); cytology (Bold); sexuality of algae (Smith); the pigments of algae (Strain); physiology and bio-chemistry

(Blinks); ecology of fresh water (Tiffany) and of marine (Feldmann) algae; and marine phytoplankton (Ketchum). The book ends with two useful appendixes; one on methods of cultivating algae (Pringsheim) and the second on microtechnique (Johansen). In these chapters the considerable gaps in our knowledge are repeatedly pointed out. This is true also of the earlier chapters but to a lesser extent. The need of more extended research is especially brought out in the chapter on cytology and in that on physiology and biochemistry and Blinks dealing with the latter subject concludes with the statement that: "If the present sketch has served to suggest any possible researches, it will have served a useful purpose" (p. 283). We may add that if it does not do so no blame can be laid at the door of the writer. The need for many further researches is also made clear by Feldmann, especially in the concluding section of his chapter on the ecology of marine algae.

It is somewhat invidious to single out any of these chapters for special mention. Attention, however, may be called to Feldmann's lucid and illuminating chapter on the ecology of marine algae, although the section on the marine vegetation of different parts of the world, at least partly due to considerable condensation, is not as satisfactory as the rest of the chapter. On p. 323, *Porphyra* is described as a hypnophycean passing the unfavourable season as a protonema. It may be remarked that the *Porphyra capensis* association on the West Coast of South Africa persists throughout the year.

It is a pity that Ketchum in his chapter on plankton algae limited his account to the factors determining growth and photosynthesis. A treatment of other themes would have been welcome such as a general account of annual plankton cycles and of such special relationships as have been worked out between irregularities in herring migrations and the distribution of *Phaeocystis* and diatom species and between phosphate values, phytoplankton and whale distribution.

The text contains a number of printer's errors: "severed" for "served" on p. 8, "place" for "placed" on p. 14, "(Fig. 38G)" for "(Fig. 39G)" on p. 176, "chrondriosomes" for "chondriosomes" on p. 203. In chapters 14 and 16 there is also some lack of agreement between the dates of literature citations in the text and in the corresponding bibliography. It is incorrect to state (p. 17) that the unilocular reproductive organs of Phaeophyta always contain more than one reproductive body.

In spite of various shortcomings the Manual of Phycology is a valuable addition to the books on algae for advanced students and research workers and should prove a stimulus to further research on many problems of phycology.

Wm. Edwyn Isaac.

TRACE ELEMENTS IN PLANT PHYSIOLOGY. *Lotsya*, Vol. 3—I.U.B.S. Colloquia, Series B, No. 1. Waltham, Mass. The Chronica Botanica Co. London, W.C.2: William Dawson & Sons, Ltd. 1950. $4·50.

This publication is a report of the proceedings of a Symposium on trace elements held at Rothamsted in November, 1947. The Symposium was organized by the International Union of Biological Sciences and supported by Unesco. The report contains contributions by workers from Britain (Wallace, Hewitt), Czecho-Slovakia (Nēmec), Denmark (Steenbjerg), Finland (Erkama, Jamalainen), France (Lavollay), Netherlands (Mulder, Löhnis, Seekles), Sweden (Burström), Switzerland (Gisiger), and U.S.A. (Arnon). The contributions are in English save that of Lavollay. At the end of most contributions points arising from the discussion which followed are recorded.

As indicated in the Preface, the background of the Symposium was the intensified wartime realization of the importance of trace elements in agriculture and horticulture. Consequently taken as a whole, the main emphasis is on practical problems. While this emphasis is evident throughout, it is paramount in the contributions on zinc deficiency of fruit trees in Europe (Mulder), micro-elements from a practical point of view (Steenbjerg), the role of trace elements in the agriculture of Finland (Jamalainen), and in Wallace's contribution on the application of visual methods in the diagnosis of trace element deficiencies and excesses in plants.

Theoretical considerations, however, are not neglected and the functions of trace elements in plant metabolism are discussed by Burström, Erkama, Lavollay and Mulder. Burström deals with the action of nitrogen, iron and manganese on roots; Erkama with the effect of copper and manganese on the iron status of higher plants; Lavollay with the quantitative interactions of nutrients in *Aspergillus niger*; Mulder with copper and molybdenum in the nutrition of micro-organisms and higher plants.

The Symposium ends with a contribution by Seekles on the "Mode of Action and Occurrence of Trace Elements in Pastures and in the Blood and Liver of Farm Animals". This contribution serves to indicate the linking up of plant nutrition with problems of animal and human nutrition.

A detailed survey of the field of micro-nutrients, even from an empirical point of view, will not be found in this publication, but the contributions and points arising from discussions should stimulate further research and thought on a number of topics.

WM. EDWYN ISAAC.

MYCOTROPHY IN PLANTS: LECTURES ON THE BIOLOGY OF MYCORRHIZAE AND RELATED STRUCTURES. By Arthur P. Kelley. Waltham, Mass. The Chronica Botanica Co. London, W.C.2: Wm. Dawson and Sons, Ltd. 1950. $5·00.

This volume is presented as a general introduction to the problems of mycorrhizal relationships between fungi and the higher plants. It is difficult to see why the 12 chapters should have been termed "Lectures", as they consist essentially of a series of short abstracts of the published work on various aspects of the biology of mycotrophic plants, with very little critical comment. This makes the work a useful reference-book for workers in the field of mycorrhizal relationships but limits its value as an introduction to the subject for the non-specialist.

Topics dealt with are the history of mycotrophic studies, the occurrence of mycorrhizae, the distribution of mycotrophic plants and their environment, the structure of mycorrhizae, the question of whether the relationship is an obligate one, the phenomenon of mycotrophic phagocytosis and theories of the nature of the relationship.

The author rightly emphasizes the necessity of more taxonomic and morphological work, and of further exploration of the plant kingdom to determine the extent of the phenomenon, in view of its possible importance in connexion with the problem of the absorption of nutrients by roots.

The text contains a number of misprints, and a misplaced footnote. The bibliography is extensive.

L. OLIVIER.

MANUAL OF BACTERIAL PLANT PATHOGENS. By Charlotte Elliott. Second revised edition. Waltham, Mass. The Chronica Botanica Co. London, W.C.2: Wm. Dawson and Sons, Ltd. 1951. $6·00.

This work, which is Volume 10 of the Chronica Botanica Company's Annales Cryptogamici et Phytopathologici, is one strongly to be recommended to any worker in the field of agricultural bacteriology or plant pathology.

It consists of a list, alphabetically arranged, of all the known bacterial plant pathogens, with their sources and synonymy, morphological features, staining reactions, physiological characteristics and behaviour in culture. A list of the host plants reported for each pathogen is given, and the disease symptoms produced are described in detail. The geographical distribution of each organism is indicated, and control measures are given. The literature citations for each organism are arranged in chronological order. Nomenclature is based on the 1948 edition of Bergey's Manual of Determinative Bacteriology, and the author's preface gives a brief and lucid explanation of the reasons for the transference of certain groups from Phytomonas to Pseudomonas and to Corynebacterium, and of the characteristics of the two new genera, Xanthomonas and Agrobacterium. There are two indices, one of genera and species of bacteria, the other of plant hosts.

L. OLIVIER.

NATIVE ORCHIDS OF NORTH AMERICA. By Donovan S. Correll. Pp. xvi and 399, including Frontispiece (2), plus 146 plates and 7 text figures of line drawings. Waltham, Mass., U.S.A. The Chronica Botanica Co. London, W.C.2: Wm. Dawson and Sons, Ltd. 1950. $7·50.

This book, by Dr. Donovan S. Correll, is an important contribution to orchidology. It brings together for the first time an account of all North American orchids (which have so far been recorded) from north of Mexico to beyond the Arctic tree-line—a vast area, with extremely diverse conditions in regard to geology, topography and climate, with the result that the orchid flora dealt with ranges from the modest bog-loving terrestrial in the north, to the epiphytes in the southern, sub-tropical parts.

A total of 46 genera, comprising something like 169 species (including one or two varieties and natural hybrids) are dealt with. The author supplies a key to the genera, and the arrangement of the genera in the book follows Rudolph Schlechter's system.

Besides full descriptions of each species, the author furnishes extensive notes, including synonyms, meaning of the scientific names, common names, flowering times, type locality and geographical distribution.

A feature is the cultural requirements, where known, of each species—with much valuable data supplied in this respect by Prof. Wherry and Mr. John V. Watkins.

Finally the beautiful and accurate line drawings, supplied by Mrs. Blanche Ames Ames and Mr. Gordon W. Dillon, complete a book of much value to the botanist, horticulturist and orchid lover.

H. F. WERNER.

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